BEHAVIOR TO PREVENT NECK AND SHOULDER PAIN AMONG STUDENTS OF SMARTPHONE USERS AT HAINAN VOCATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY IN YUNLONG CAMPUS

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摘要

题目：海南科技职业大学云龙校区智能手机学生用户预防颈肩痛行为研究。

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这项横断面描述性研究旨在考察海南科技职业大学云龙校区智能手机学生用户中学生颈部和肩部疼痛的患病率、程度及预防行为。研究采用分层抽样技术，共选取了 428 名学生。研究工具包括个人因素、使用智能手机的特点、肌肉骨骼不适评估（MSDA）以及预防肩颈疼痛的行为。数据通过频数、百分比、平均值和标准差进行分析。

结果显示，过去一个月，颈部和肩部疼痛的一般情况。80.84%的学生报告了较高的颈部疼痛率，而 64.95%的学生感到右侧肩部疼痛，55.61%的学生感到左侧肩部疼痛。过去一个月，颈部和肩部疼痛的程度。颈部的平均疼痛水平最高（4.46±2.44），被归类为中等。右侧肩部（3.66± 2.90）和左侧肩部（3.04±2.89）均被归类为轻微疼痛。预防颈部和肩部疼痛的行为总体平均得分良好（3.22 ± 0.76）。年龄

和学习年限与使用智能手机的学生预防颈部和肩部疼痛的行为相关性显著（P<0.05）。此外，关于预防颈部和肩部疼痛的因素和行为的研究结果可以应用于学生的日常习惯，以帮助减少肌肉骨骼不适。

关键词: 行为，智能手机用户，颈部疼痛，肩部疼痛

ABSTRACT

Title: Behavior to Prevent Neck and Shoulder Pain among Students of Smartphone Users at Hainan Vocational University of Science and Technology in YunLong Campus.

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This cross-sectional descriptive study aimed to examine the prevalence and severity of neck and shoulder pain, as well as behaviors to prevent such pain, among smartphone users at Hainan Vocational University of Science and Technology, Yunlong Campus. A total of 428 students were selected using a stratified sampling technique. The research instrument was a questionnaire that included sections on personal factors, characteristics of smartphone use, musculoskeletal discomfort assessment (MSDA), and behaviors to prevent neck and shoulder pain. Data were analyzed using frequency, percentage, mean, and standard deviation.

The results showed a high prevalence of neck and shoulder pain in the past month. Specifically, 80.84% of students reported experiencing neck pain, while 64.95% reported pain in the right shoulder and 55.61% in the left shoulder. Regarding pain severity in the past month, the neck had the highest average pain level (4.46±2.44),

which was categorized as moderate. The right shoulder (3.66 ± 2.90) and left shoulder (3.04 ± 2.89) were classified as experiencing mild pain. The overall mean score for behaviors to prevent neck and shoulder pain was at a good level (3.22 ± 0.76). Age and year of study were significantly associated with preventive behaviors among smartphone users ($P<0.05$). These findings suggest that factors and behaviors related to the prevention of neck and shoulder pain can be integrated into students' daily routines to help reduce musculoskeletal discomfort.

Keywords: Behaviors, Smartphone users, Neck pain, Shoulder pain

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CHAPTER I

INTRODUCTION

Background and Rationale

As an indispensable communication tool for modern people, smartphones have experienced rapid development in the past few decades, from the initially bulky to now intelligent and convenient, bringing great changes to people's lives. In the 1970s, the concept of mobile phones was first developed and started to be developed. At that time, mobile phones were huge and needed to be powered by large batteries, which were difficult for ordinary people to own. With the development of technology, smartphones were born. It's a milestone. The so-called "smartphone" is a phone that can install and uninstall applications at will. Half of Internet users (50%) spent 5 to 12 hours a day on the Internet, an increase of 13% from 37% observed in 2018 and all mostly use the Internet for social purposes like communicating through text, communicating via voice/ video and visiting social networking sites (Malaysian Communications and Multimedia Commission, 2020). Recently, the latest report released by the international market research agency Canalys shows that the global smartphone shipments will be 1.14 billion in the whole year of 2023. On March 22, 2024, the China Internet Network Information Center (CNNIC) released the 53rd Statistical Report on China's Internet Development. The report showed that by December 2023, China's Internet users would reach 1.92 billion, and the Internet penetration rate would reach 77.5%. The size of rural Internet users was 326 million, and the size of urban Internet users was 766 million. The average Internet time per week

was 26.1 hours; The number of mobile Internet users in China reached 1.91 billion. The proportion of Internet users using mobile phones to access the Internet reached 99.9%, and the proportion using desktop computers, laptops, TV, and tablet computers was 33.9%, 30.3%, 22.5%, and 26.6%, respectively (Statistical Report on Internet Development in China, 2024). In addition, children and adolescents spend 5 to 7 hours a day on smartphones. It can be seen that, under the global governance concept of extensive consultation, co-construction, and sharing, following the general trend of interconnection in the world, mobile phones have become a highly used Internet access device, which has been integrated into every aspect of people's lives and has become an indispensable media device.

Due to the high market penetration rate of smartphones and the rapid development of technology, smartphones of various brands are also constantly being updated. The performance of smartphones has become more diversified and convenient for people to choose from. Among the many functions of smartphones, seven functions are given as examples. 1. Social communication function: It is one of the most basic functions of smartphones. Communication is carried out through Facebook, Line, WhatsApp, and other software. From voice to video to virtual social media images, the call process is becoming more and more colorful, and the number of More interactive and personalized elements makes it easier to communicate with others (Xu Yong and Xiao Dong, 2024). 2. Network functions: With the high penetration of global broadband and information sharing, through the smartphone network, you can browse the web, download various software anytime and anywhere, and order food easily through Mei tuan, Ele.me, Grab, and other software without leaving home. In a cross-sectional study of college students attending Beijing University in China, all participants surveyed

consumed take-out food per week; moreover, nearly one-third of them consumed it 9–15 times per week (Qi qi et al., 2023). 3. Audio-visual entertainment functions: Watch movies and take photos through smartphones. The image quality of smartphone cameras has reached a very high level and is becoming more intelligent and automated. Carrying it around allows more non-professionals to easily take satisfactory photos. (Ma Xinyan Ma, 2024), listening to music can see the outstanding performances of Chinese musicians, which not only makes people feel the wonderfulness and novelty of the works but also gives the works high artistic value, allowing us to experience the new pulse of contemporary China and New Voices (Jiao Ziyu, 2024); playing various games such as "Peace Elite" builds a hyper-realistic virtual space that is similar to the real world. The realistic and exciting games help users to release stress, vent emotions, and enhance themselves. The inherent need for recognition (Tang Zhe, 2022) makes boring time more colorful. 4. Office education function: Complete various office tasks through smartphones, such as editing documents, writing papers, making slides, sending and receiving emails, etc. Users can use their mobile phones to process relevant business information while working out or during breaks, which improves the efficiency of office work. work efficiency (Wang Junzhe, 2018). 5. Sports and health functions: Using sports and health-related applications on your smartphone, such as pedometers, heart rate detectors, etc., to measure physiological parameters and track health conditions can provide information about an individual's overall health and well-being over a long period. Detailed information on well-being (Majumder, S, Deen, M. J., 2019) Pregnant women use smartphones to obtain information related to pregnancy, childbirth, and parenting (Erfaneh Talebi et al., 2022) Elderly people can self-assess their health status (Liang Xian, Xiong Feixue & Xie Fangting, 2022).

Drivers use smartphones for monitoring and driving efforts to support driving safety (Papatheocharous et al., 2023). 6. Mobile payment function: The penetration rate of the payment industry in serving the real economy and people's livelihood needs has increased year by year, and has become one of the distinctive highlights and important symbols of my country's financial services (Ye Qing, 2024). Shopping and payment can be completed through WeChat and Alipay. Utility bills, even if you forget to bring your smartphone and wallet, you can still complete the payment by entering your relevant information on the machine with facial recognition payment. However, it cannot be ignored that many elderly people and foreigners in China face the "digital gap" in payment "From the perspective of policy implementation, since the beginning of this year, with the successive introduction of the entry visa-free policy, the number of foreigners coming to China has continued to increase. More than 2 million immigrants have used mobile payment, and the number and amount of transactions have increased by more than 80% compared with February. It can be seen that the importance of payment convenience optimization is highlighted (Wang Kejin, 2024). 7. Map and navigation functions: You can check locations, routes, real-time traffic, etc. on smartphones. According to statistics, domestic smartphone shipments in 2023 will be 276 million units, of which 269 million smartphones will support Beidou positioning functions, accounting for about 98%. (Li Zhengfen, 2024), Smartphones can create favorable conditions for a rich and valuable outdoor life (Nielsen and Arvidsson, 2021).

The thoughts of contemporary college students are characterized by autonomy, diversity, fluidity, and networking (Ye Changqing, 2023). Although the mobile phone network space only meets their psychological needs, at the same time, college students cannot distinguish information and are easily immersed in various

contents in the network space and immersed in the virtual world of smartphone networks for a long time (Li Fei and Pan Yongfu, 2023). Students spending more time using electronic devices to support their academic and leisure activities will increase the incidence of neck pain and seriously affect students' musculoskeletal health. When using a smartphone, the body movement is greatest in the lying position, followed by the sitting position, which generates a lot of movement and exacerbates ergonomic risks. Ergonomic studies have shown that using mobile electronic devices results in higher than desktop and worse head and neck posture for computers. When the mobile device is placed flat on a table or held below eye level, and the gaze angle is below 45 degrees, neck extensor muscle tension increases significantly, and the lengthened cervical spine produces flexion, which may cause the muscles to bear greater stress. Loading and simultaneous activation of neck flexors and neck extensors can create specific stress areas and cause postural neck pain. When college students at the University of Gondar in Ethiopia use smartphones, 81.6% of the students use a neck flexion posture to keep the phone below eye level (Mongkon Kansai et al., 2022). On the other hand, sitting without back support can also increase the probability of neck and shoulder symptoms (Li Yinwen et al., 2020). The incidence of neck pain among college students is very high (48% ~ 78%). The incidence of cervical spondylosis among college students is rising rapidly, with an annual growth rate seven times that of people over 50 years old (Gao Yifang et al., 2023).

With the increasing integration of smartphones into students' daily lives, prolonged and improper usage has led to a growing concern over physical health, especially musculoskeletal issues such as neck and shoulder pain. Despite the widespread use of smartphones, awareness and preventive behaviors to reduce these

health risks remain limited among students. The main reason for neck and shoulder pain is postural strain caused by long-term downward movement of mobile phones. When students continue to use their smartphones in a bad posture of leaning forward with their heads and bent over hunching their backs, the pressure on the cervical spine can reach 3-5 times that of the normal upright state, resulting in the proximal cervical muscles being in a static load state for a long time, causing local blood circulation disorders and lactic acid accumulation. In addition, the repetitive forward movement of the neck and shoulder during touchscreen operation can easily cause fatigue damage to the trapezoidal muscles and the levator scapula, and the lack of standardized ergonomic equipment support (such as smartphone stands) in the campus environment. In addition, some students are addicted to short videos or games, resulting in a single use time of more than 2 hours, which ultimately leads to compensatory strain on muscle and ligament, disorders in the cervical spondylosis and other health problems. This research study assesses the prevalence and level of neck and shoulder pain, the behavior to prevent neck and shoulder pain, and identify the risk factors related to neck and shoulder pain behavior prevention among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus.

Objective

1. To study the prevalence and level of neck and shoulder pain among students at Hainan Vocational University of Science and Technology in Yunlong Campus

2. To assess behavior to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus

3. To identify the personal factors associated behaviors to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology university.

Research question

1. What is the prevalence and level of neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus?

2. What are the behaviors to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus?

3. What are personal factors associated with neck and shoulder pain behavior prevention among students of smartphone users at Hainan Vocational University of Science and Technology University.

Hypothesis

1. The students at Hainan Vocational University of Science and Technology in Yunlong Campus, experience moderate to high levels of neck and shoulder pain due to smartphone use.

2. The students at Hainan Vocational University of Science and Technology in Yunlong Campus, demonstrate good behavior to prevent neck and shoulder pain

3. The personal factors associated with neck and shoulder pain behavior prevention among students of smartphone users at Hainan Vocational University of Science and Technology University.

Operational Efinition.

Body posture refers to the positional relationship of various parts of the body. Correct body posture refers to a state in which the body can maintain a stable state for a long time in an upright or sitting position, maintain the normal function of various tissues and organs, and maintain appropriate tension in joints, ligaments, and muscles. A normal body state. The body posture is more inclined to the natural and relaxed state of the arrangement of the joints of the body and the functional state of the muscles. It is formed according to personal wishes through the long-term accumulation of personal posture and behavior habits, and without the need for deliberate control. a relatively permanent state of nature.

Neck and Shoulder pain refers to it as a clinical symptom, not the name of a disease. Its clinical manifestation is mainly pain in the neck, mainly at the attachment points of our neck muscles, such as our occiput. Pain at the attachment points of these muscles in the neck, shoulder and back, as well as nerve compression, may cause radiating pain and numbness in the shoulders, upper limbs, forearms, and even hands.

Prevalence of neck and shoulder pain refers to the proportion of cases of neck and shoulder pain among students of smartphone users at Hainan Vocational

University of Science and Technology in YunLong campus, from August 2024 to May 2025, relative to the total student population.

Level of neck and shoulder pain refers to the level of intensity of one's own pain in the neck and shoulder region.

Behavior refers to behaviors adopted for the prevention and relief of neck and shoulder pain

Smartphone user refers to the students at Hainan Vocational University of Science and Technology in YunLong campus who own and use smartphones daily.

Using smartphones in class refers to students using smartphones in class for non-study purposes.

Using smartphones for activities refers to using smartphones to carry out activities, such as watching videos, playing games, etc.

Using social media platforms refers to utilizing services and platforms provided by the Internet for content creation, interacting, and communicating with others.

Spending time on a smartphone refers to the time spent using smartphones within 24 hours

Taking a break after using smartphones refers to using the smartphone for 20 minutes or more, then stopping using it and giving your body a rest in all aspects.

Using a laptop/ tablet besides smartphones refers to apart from using smartphones, one also uses laptops/tablets to carry out various activities in daily life.

Holding posture smartphones refers to holding the smartphone at different heights, causing the smartphone screen to be above the line of sight, at the same level as the line of sight, or below the line of sight.

Handedness refers to a person's habit of using the right or left hand in daily life.

The most frequently used activities on smartphones refer to the numerous activities that smartphone users undertake, they select the one that they use most frequently.

Expected Benefits and Applications

Individuals

1. Let students know about the prevalence of shoulder and neck pain among college students and the different degrees of pain caused to the shoulder and neck, make them realize the seriousness of this problem, and motivate them to take measures to prevent or relieve pain.

2. The findings of this study may encourage students to increase various activities to prevent shoulder and neck pain and to perform related muscle-strengthening exercises.

Organizations

1. The school will carry out a relevant physical examination to obtain students' use of smartphones and shoulder and neck information, to improve the awareness of the rational use of smartphones.

2. Organizing activities to explain, share, and exercise the behavior of shoulder and neck prevention not only increases the knowledge but also improves the health of the shoulder and neck

CHAPTER II

LITERATURE REVIEW

This chapter several concepts were outlined in this chapter to explain the overall conceptual framework into which the research was laid. Below are specific studies which were reviewed to support this research as follows:

1. Smartphone user
    1.1 Smartphone penetration rate
    1.2. Smartphone usage time
    1.3. Smartphone usage posture
2. Neck and shoulder pain
    2.1. The concept of neck and shoulder pain
    2.2. The current situation of neck and shoulder pain
    2.3. The cause of neck and shoulder pain
3. Ergonomics
    3.1. The concept of ergonomics
    3.2. Risk factors of ergonomics
    3.3. Related research on ergonomics
4. Behavior
    4.1. Posture correction
    4.2. Functional training
    4.3. Physical exercise
5. Research related to this study

6. Conceptual Framework

Smartphone user

Smartphone users refer to people who own and use smartphones daily. The smartphone users in this study are the students at the Yunlong Campus of Hainan Vocational University of Science and Technology who own and use smartphones daily.

1. Smartphone penetration rate

China, India, and the United States have the largest number of smartphone users. In the United States, 95% of teenagers aged 13-17 years old use smartphones daily (Lucia Fortunato et al., 2023). In Denmark, 90% of the population owns a smartphone and most children have their smartphone by the age of 9. This early exposure to screen media usage is higher than in countries such as the United States and the United Kingdom, accounting for 42% in the United States, 50% of UK 10-year-olds own a smartphone, compared to 93% in Denmark (Gitte Frydenlund et al., 2023).

2. Smartphone usage time

The average daily frequency of smartphone use (in days/week) is 798 times (92.0%), but the minimum is 20 times (2.3%), lasting 1-2 days. The overall average number of hours spent on smartphones per day shows that the maximum percentage is 465 (53.63%) equal to or greater than 4 hours and the minimum percentage is 402 (46.37%) less than 4 hours (Mikhled Falah Maayah et al., 2023). The prevalence of NSP is positively correlated with the time spent using various electronic devices (Wang Ruilong et al.,2023). In Switzerland, 50% of teenagers and young adults use

smartphones for more than 3 hours a day, 43% in the United States, and 44% in South Korea (Jong ho Cha et al., 2023).

3. Smartphone usage posture

Rachel Eardley et al (2018) studied different body postures (sitting at a table, lying down, and standing) when interacting with smartphones. The results showed that the body posture moved the most when lying down, followed by sitting at a table and finally standing. Julien Jacquier-Bret and Philippe Gorce（2023）investigated the impact of time of day on the postures taken by college students when using smartphones, considering four times of the day, namely morning, afternoon, evening, and evening, and a taxonomy of 41 postures called SmarTaxo. The 41 postures included in SmartTaxo were defined biomechanically. SmarTaxo includes 13 sitting postures, 6 standing, 7 lying, and one during walking for texting, web browsing, watching videos, gaming, photos, and selfies. The taxonomy of 41 postures evaluated in the DT-SUP with their corresponding RULA score is shown in Figure 1.

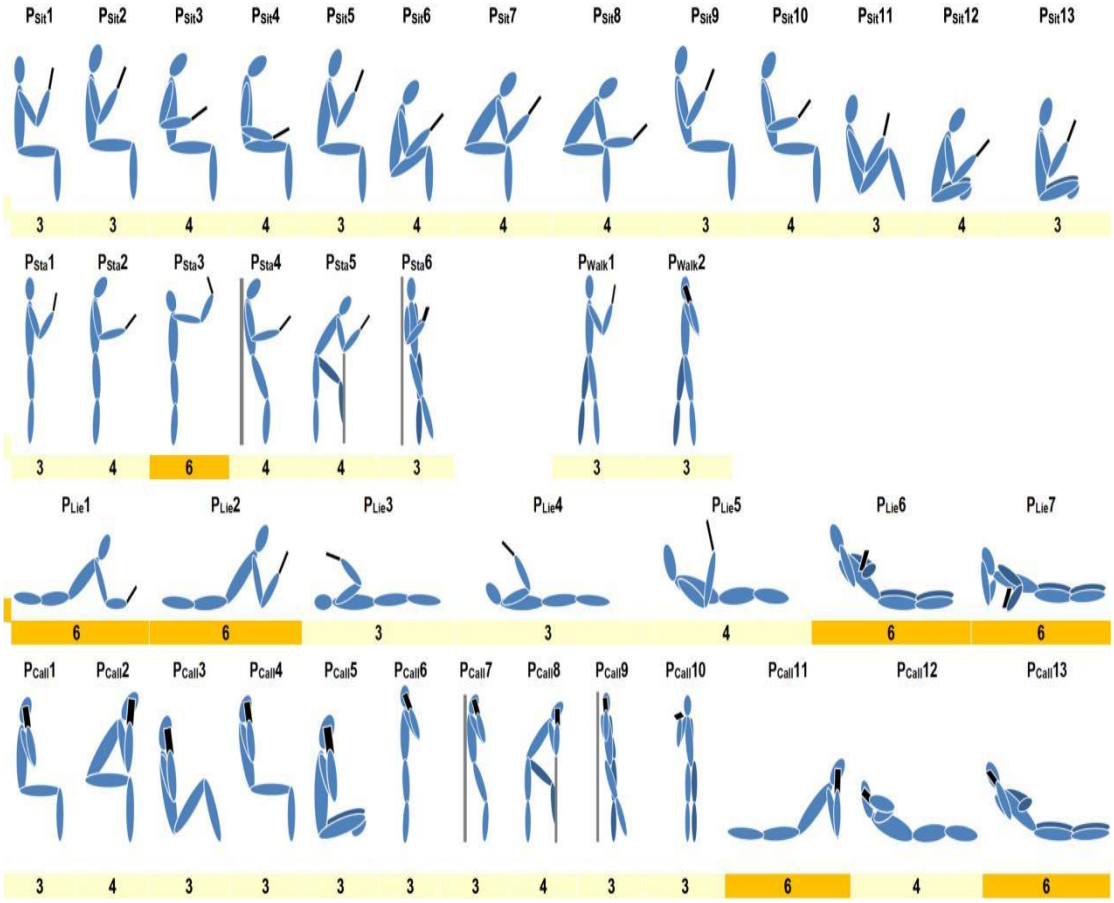


Figure 1 Taxonomy of 41 postures evaluated in the DT-SUP with their corresponding RULA score (Julien Jacquier-Bret and Philippe Gorce, 2023).

Neck and shoulder pain

1. The concept of neck and shoulder pain

Neck and shoulder pain (NSP) is caused by a group of diseases involving dysfunction of the cervical spine, nerves, or soft tissues. NSP is defined as the presence of muscle tension, stiffness, compression, or dull pain in the area extending from the individual's neck to the scapular arch (Eiji Takasawa et al., 2015).

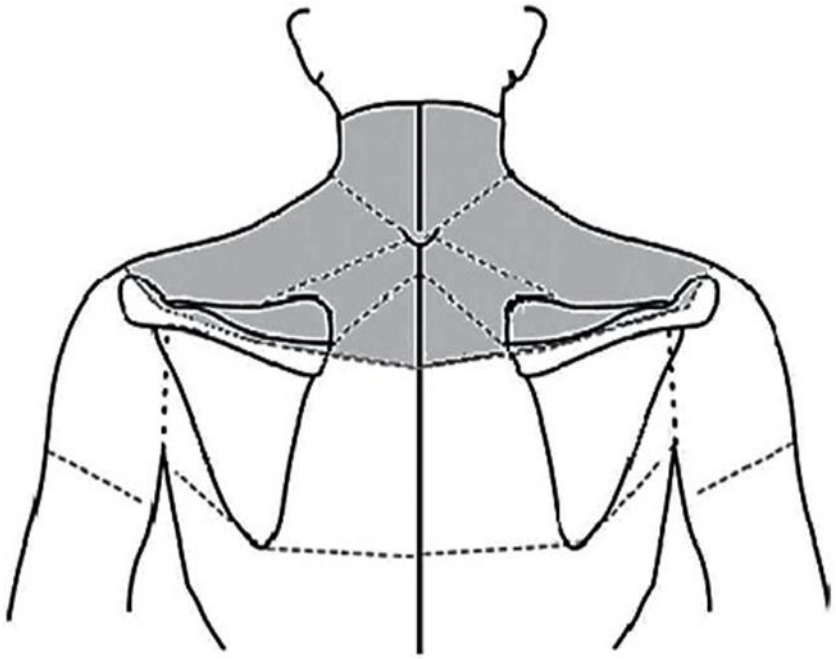


Figure 2 Schematic diagram of NSP locations recorded in humans (Eiji Takasawa et al., 2015)

2. The current situation of neck and shoulder pain

Neck and shoulder pain are relatively common clinically and are also a common disease and a frequently occurring disease in community medical care. Neck pain increases the need for medical services and the financial burden of absenteeism (Diao Taichang, 2002). Young adults with neck and shoulder pain demonstrate altered motor control, including increased muscle activity in the cervical erector spine and upper trapezius muscles, when performing text messaging and typing tasks (Yanfei Xie et al., 2018). Neck and shoulder pain are more common among children and adolescents in developing countries, with 72.55% of students reporting neck or shoulder pain. In addition, the highest pain location was the neck at 48.44%, followed by the right shoulder at 16.03%, and the left shoulder at 6.57% (Mikhled Falah Maayah et al., 2023). Nowadays, neck and shoulder pain not only occurs in middle-aged and elderly

people, but also among college students, senior high school students, and even junior middle school students. A considerable number of people suffer from neck and shoulder pain (Xu Yongfeng and Zhang Li, 2019). The above literature summary can show how to alleviate and prevent the impact of neck and shoulder pain on life, work, and study has reached an urgent and critical period.

3. The causes of neck and shoulder pain

Neck and shoulder pain is caused by many factors. In different studies, gender, lack of exercise, bad posture, age, staying up late, using electronic products for a long time every day, bowing for a long time, etc., have been identified as risk factors associated with students' neck and shoulder pain. In addition, smoking and drinking alcohol also increase the risk of neck and shoulder pain. The following sections describe the research evidence for several factors associated with neck and shoulder pain.

Gender. The incidence of neck and shoulder pain in women is higher than that in men (Katherine Bubric and Hlan Hedge, 2016). Age. As age increases, soft tissues also degenerate accordingly. Lack of exercise. Lack of basic physical exercise or insufficient exercise (Liu Qinzhou and Wang Ying,2022).

Bad posture. Playing mobile phones in fixed or incorrect body posture for a long time, as well as sports and movements (Huang Ruqian et al.,2023).

Stay up. According to the "White Paper on the Sleep Health of Chinese Residents 2024" (hereinafter referred to as "White paper") recently released by the China Sleep Research Society, the post-00s generation is the main force staying up late, and the average time to fall asleep is 0:33; Among the college students who participated in the survey, 52 percent fell asleep between midnight and 2 a.m., and 19 percent fell asleep later than 2 a.m. (Yu Bingyue et al., 2024). This period has become the best

choice for working overtime, reading, and learning, or various night activities, but the muscle is in a state of fatigue, significantly reducing the muscle strength and flexibility of them reduced prone to abnormal muscle injury (YangXin, 2024).

Using electronic products for long periods every day. Population-based studies have shown that the prevalence of neck pain ranges from 12% to 34%, with a higher prevalence of symptoms among portable electronic device users. Prolonged use of computers, smartphones, and other electronic devices is very common among college students (Meshari Musaad Almalki et al., 2017). Children and adolescents spend 5 to 7 hours a day on smartphones and handheld devices, with their heads bent forward to read and text (Daniela David et al., 2021).

Bow your head for a long time. Students who read in a static head-down position for 5 hours or more per day were 3.26 times more likely to suffer from shoulder and neck pain (Gidey Gomera Weleslassie et al.,2020).

Smoking. One study found that current smokers had an increased incidence of pain in various body regions compared with never smokers. (Xu Haoran Xu et al., 2023). The substances present in cigarette smoke harm cell integrity and metabolism, reduce blood flow to tissues, and disrupt collagen synthesis, which can eventually lead to cell death (Łukasz M. Jaworski et al,2024).

Drinking, acute and chronic alcohol use lead to changes in skeletal muscle mass and function that decrease protein synthesis and increase protein degradation (Liz Simon, Brianna L Bourgeois, & Patricia E. Molina, 2023).

Ergonomics

1. The concept of ergonomics

In August 2000, the International Ergonomics Association (IEA) revised the definition of ergonomics: the study of human factors in various working environments, the study of the interaction between humans and machines and the environment, and the study of the science of how to uniformly consider issues such as work efficiency, people's health, safety and comfort at work, in life and on vacation. Ergonomics is composed of the Greek words "ergo" and "nomos". "Ergo" means work, "nomos" means the natural law of work, and Ergonomics originally means the natural law of work (Harshal T Pandve, 2017). A discipline that studies the interactions between people, objects, and the environment. Domestic scholars in China believe that ergonomics is a science that uses knowledge from physiology, psychology, biomechanics, and other related disciplines to make machines and people adapt to each other, create comfortable and safe environmental conditions, and thereby improve work efficiency.

2. Risk factors of ergonomics

Ergonomic hazards refer to factors that exist in the work environment that may cause harm to human health and safety. These factors can affect the human body's posture, movement, strength, feeling, concentration, and mental state, leading to related illnesses or accidents. Four types of ergonomic risk factors are described below:

1. Awkward posture. Poor or altered posture can put considerable stress on surrounding muscles and ligaments, ultimately affecting the stability of the spine. It also causes strain and fatigue of surrounding structures, which often leads to pain. For

example, forward head tilt (FHP) is one of the most common cervical postural deviations, which is characterized by head protrusion or forward placement of the head relative to the shoulders in the sagittal plane, often causing neck and shoulder pain (Seoyon Yang et al.,2023)

2. Repetitive strain injury (RSI). It is an injury to parts of the musculoskeletal or nervous system caused by repeated use, vibration, compression, or being in a fixed position for a long time. Typically, it occurs in the arms, neck, and shoulders (Amal I Elsiddig et al.,2022).

3. Inappropriate desk and chair heights. Desks and chairs that are too high or too low can lead to muscle fatigue, discomfort, and poor posture. Because students spend about 7-8 hours a day sitting in chairs during lectures and other activities during college, and desks and chairs are not designed according to students' anthropometric measurements, leading to musculoskeletal problems, shoulder, neck, back, Pain in areas such as the waist (Mudasar Irfan et al.,2023).

4. Long periods of sitting still or in a fixed position. Staying still for long periods can lead to muscle fatigue, poor circulation, and bone problems. Prolonged posture maintenance can lead to soft tissue overload, leading to painful conditions (Magdalena Plandowska et al., 2024).

3. Related research on ergonomics

Risk factors such as awkward postures, repetitive strain injuries, and inappropriate desk and chair heights can lead to musculoskeletal symptoms, and the use of ergonomic guidelines is recommended to avoid such problems. The process of participatory ergonomics (PE) has been identified as an important way to prevent musculoskeletal problems (Karen Davies et al.,2023). The experimental group received

an ergonomic intervention that reduced pain intensity in the neck, shoulders, upper back, and wrist/hand (Stefany Lee et al., 2021).

Behavior

1. Posture correction

1.1 Correct body posture. Body posture refers to a state in which the body can maintain a stable state for a long time when upright or sitting, maintain the normal functions of various tissues and organs, and maintain appropriate tension of joints, ligaments, and muscles. It is formed according to personal wishes through the long-term accumulation of personal postures and behavioral habits and does not require deliberate control. A relatively permanent state of nature. Good posture means keeping the cervical, thoracic, and lumbar curves in balance and aligned, with weight distributed evenly over the feet. Seen from the side, your ear, shoulder top, hip, knee, and ankle should line up vertically when you're standing. The back has three natural curves: a slight forward curve in the neck (cervical curve), a slight backward curve in the upper back (thoracic curve), and a slight forward curve in the lower back (lumbar curve). When these curves are in proper alignment, the spine, shoulders, hips, knees, and ankles are in balance, and body weight is evenly distributed. The payoff is less stress and strain on muscles, joints, and ligaments, and a reduced risk for back, neck, and shoulder pain. (Harvard Health Publishing Harvard Medical School, 2020).

1. 2 Abnormal body posture. All abnormalities in human posture are generally referred to as postural deformities, and factors leading to the adoption of inappropriate body postures certainly play an important role. Over time, they lead to

the formation and retention of habits of adopting inappropriate postures, thereby contributing to the development of musculoskeletal diseases (A Górecki et al.,2009). Common abnormal body postures include forward head tilt, rounded shoulders, pelvic tilt forward and backward, knee hyperextension, foot arch collapse, high and low shoulders, X-shaped legs, O-shaped legs, etc. For example, forward head posture (FHP) is a head and neck flexion posture associated with neck disorders that are increasingly seen in young adults due to multiple environmental/ behavioral factors (Yuichi Nishikawa et al.,2022). Round-shouldered hunchback refers to a posture problem caused by the forward-leaning of the shoulders and the forward curvature of the back. Due to long-term sedentary life and excessive use of smartphones, computers, and other electronic products, long-term muscle tension and incorrect postures can easily lead to rounded shoulders and hunched back. To sum up, abnormal body posture is usually caused by changes in muscle length and tension, resulting in compensation. The interactive inhibition of the prime movers and antagonist muscles that maintain the correct posture is changed, and the prime movers and synergist muscles that work together to stabilize the posture are changed. The main coordination of the joints changes, and the relative flexibility of the joints changes, causing the bones and joint positions to shift, resulting in body posture problems (Zhao Qiuying,2022). Bones are the basis for supporting the human body to walk and move freely. Once a bad posture is formed, it will have adverse effects on the bones. Patients who have been in bad posture with rounded shoulders and hunched back for a long time will suffer from stiffness, soreness, and other uncomfortable symptoms in the neck (Lin Yuting,2023).

1.3. Posture correction. The most commonly used intervention for early-stage bad posture that does not cause substantial disease is through physical exercise. For those who cause substantial disease, timely medical treatment should be taken and corresponding treatment measures should be taken. Prevent further musculoskeletal development. Photographic methods for body posture assessment, use of possible photographic parameters in diagnosing postural pathology in children, and monitoring the effects of corrective treatments (L Stolinski et al., 2017). It is possible to improve body posture in adolescents through targeted strength, stretching, and body awareness training (Oliver Ludwig et al., 2018). By training the deep cervical stabilizer muscles, it can effectively reduce the pain and dysfunction in patients with non-specific neck pain, and correct abnormal postures (Sun Zhenshuang et al.,2023).

2. Functional training

2.1. Nature of functional training. Functional training first originated in the field of rehabilitation in the United States. "Movement-Functional Movement Training System" proposes that functional training not only emphasizes the rationality of human body movement patterns and movement quality, but also points out that different links such as spinal cord strength, movement patterns, recovery and reconstruction, and kinetic chains are used to improve Scientific and systematic training can adjust and standardize the basic posture of the body to a certain extent.

2.2. Benefits of functional training. Physical function training promotes students' ability to cooperate with each link of the body and each muscle group when the body is unstable and unbalanced and exercises deep-seated muscles (Wang Ning, 2016). Functional strength training programs are more effective in improving movement quality, muscle strength, flexibility, and power and may lead to better health

promotion and injury prevention (Liao Ting et al., 2019). In 2021, Guo Yu and others conducted significant positive changes in body posture after six weeks of functional training (Guo Yu et al., 2021). In 2021, Wu Beibei and others conducted 4 weeks of functional training on students from Beijing Sport University, significant improvement occurred after functional training 3 times a week, 40-60 minutes each time (Wu Beibei and Ren Hong, 2021). Functional strength training combined with aerobic training was found to enhance body composition and physical fitness. and exercise quality than traditional resistance training combined with aerobic training (Wang Zhihai et al., 2024). Therefore, it can be seen that functional training refers to a kind of physical exercise with a specific purpose to improve the body's performance in daily life and activities, focusing on basic body posture and human movement patterns.

3. Physical exercise

3.1. The concept of physical exercise. Xi Yubao (2004) believes that physical exercise is a type of sport that uses physical exercises and exercise loads as means and uses fitness, entertainment and leisure, health care and rehabilitation, and psychological intelligence exercises as activities to enhance physical fitness, improve physical and mental health, and improve and maintain body capabilities. Zhang Xiaomin (2023) defines physical exercise as a kind of physical activity that is repetitive, planned, and regular, using various sports methods to improve physical fitness, improve health levels, and entertain the body and mind. A comprehensive summary can define physical exercise as physical exercise and exercise load through sports training, health care rehabilitation, leisure and entertainment, and other activities, to achieve a complete state of physical and mental health.

3.2. Related research on physical exercise. A recent review examined the effects of physical exercise on human health. Several beneficial effects of physical exercise have been demonstrated, not only on adipose tissue, but also on organs and body systems, including skeletal muscle, bone tissue, immune system, cardiovascular system, respiratory-pulmonary, gastrointestinal, endocrine, and nervous systems, and physical exercise has been shown to reduce thermal hyperalgesia and mechanical allodynia (Enrique Verdú et al., 2021). Significant protective effect of physical exercise on musculoskeletal pain symptoms (i.e., neck pain and low back pain) (Thi Mai Nguyen, Van Huy Nguyen & Jin Hee Kim, 2021). Specific physical exercises that strengthen the neck, shoulders, and upper back do appear to reduce chronic neck pain, with the most effective being strengthening exercises, motor control exercises, and yoga / Tai Chi / Pilates (Hortensia De la Corte-Rodriguez et al., 2024). Combined with the research of the above scholars, I believe that physical exercise has a protective and relieving effect on shoulder and neck pain.

Research related to this study

Ahmad Bazazan et al. (2019) conducted to examine the effect of a posture correction-based intervention (with a biofeedback device) on the occurrence of musculoskeletal symptoms (MSS) and fatigue among control room operators in a petrochemical plant in Iran. A total of 188 office workers (91 in the case group and 97 in the control group) participated at baseline as well as at 6- and 12-month follow-up. A questionnaire survey (including the Nordic Musculoskeletal Questionnaire and Multidimensional Fatigue Inventory) and direct observations of working postures by

using the Rapid Upper Limb Assessment (RULA) method were used. The occurrence of MSS in the shoulders, upper back, neck, and low back areas, as well as the mental and physical dimensions of fatigue were found to be the most common problems. The results showed considerable improvements in working postures (in the neck, trunk, and RULA grand scores) and the occurrence of MSS (particularly in the neck, shoulders, upper back, and low back areas) and fatigue (in particular the mental and physical aspects) after the intervention.

Ansu Wang et al. (2024) reported that investigating and analyzing the current situation and factors influencing chronic neck, shoulder, and lumbar back pain among medical personnel after the epidemic. Univariate and multivariate Logistic regression were used to analyze the independent risk factors of chronic neck, shoulder and lumbar back pain in medical staff, with stepwise regression utilized to choose the optimum model. A total of 602 medical staff were polled, and the findings revealed that 588 cases of chronic neck, shoulder, and low back pain of varied severity had occurred in the previous 1 to 2 years, with a 97.7% incidence rate; logistic regression analysis revealed that anxiety level, frequency of bending over in the previous 1 to 2 years, whether related preventive measures were taken at work, gender, positive senior title, daily ambulation time, and whether the department they worked in organized independent influencing factors. The incidence of chronic neck, shoulder, and lumbar back pain among medical staff is high; its influencing factors are different and have not been systematically identified. Hospitals should take effective measures tailored to local conditions to improve the physical and mental health of medical staff.

Jittaporn Mongkonkansai et al. (2022) aimed to examine risk factors for musculoskeletal pain among primary school students using smartphones. A cross-sectional study was conducted with 233 school-aged children in Nakhon Si Thammarat, Thailand. Data collection used a questionnaire for musculoskeletal symptoms using the Nordic Musculoskeletal Questionnaire with ISO 11,226:2000. Through Chi-square, t-test, and logistic regression analysis, factors independently associated with musculoskeletal pain were determined. An important factor in the development of musculoskeletal pain was the prolonged use of smartphones for longer than 60 minutes, particularly among children aged 6-9 years old. Regarding musculoskeletal pain, almost 53% of the students used their smartphones while lying down. Posing in a prone position while using a smartphone was 7.37 times more dangerous than sitting. The lying position tilts numerous organs at varying angles, especially the upper arm. The mentioned factors may be used to anticipate the onset of musculoskeletal pain caused by smartphone use in young children.

Mohamed Sherif Sirajudeen et al. (2022) aimed to investigate the prevalence of upper limb musculoskeletal disorders (MSDs) and their association with smartphone addiction and smartphone usage among university students in the Kingdom of Saudi Arabia during the COVID-19 pandemic. A total of 313 university students aged 18 years and older who owned a smartphone and used it during the preceding 12 months participated in this cross-sectional study. The prevalence of upper limb MSDs, smartphone addiction/overuse, and levels of physical activity were recorded using the standardized Nordic musculoskeletal questionnaire, the smartphone addiction scale (short version), and the International Physical Activity Questionnaire (short form), respectively. Binary logistic regression was used to determine the association between

the prevalence of upper limb MSDs and smartphone addiction/overuse and levels of physical activity. Results showed that shoulder (odds ratio (OR) = 11.39, 95% confidence interval (CI) = 4.64−27.94, $p < 0.001$), elbow (OR = 15.38, 95% CI = 1.92−123.26, $p = 0.01$), and wrist/hand MSDs (OR = 7.65, 95% CI = 2.75−21.22, $p < 0.001$) were more prevalent among participants who were categorized as having smartphone addiction/overuse measures. Promoting awareness about the healthy use of smartphones, including postural education and decreasing screen time, is necessary to reduce smartphone-related MSDs.

Somayeh Tahernejad et al. (2021) aimed to estimate the recommended ergonomic duration for maintaining different sitting postures. Forty healthy male and female students participated in this experiment designed to measure perceived discomfort caused by maintaining common static sitting postures of office workers in a simple ergonomic set-up for 4 min. The Borg CR10 scale was given to the participants to assess the discomfort in different body parts, before and after each experiment. Based on the mean group discomfort level of 2, the recommended holding time of each posture was estimated. This concluded that the recommended holding time in this study may help to assess the risk of musculoskeletal disorders (MSDs) in office workers and train the individuals involved in office tasks in proper sitting behavior.

Burcu Babadag Savas, Guler Balci Alparslan and Cengiz Korkmaz(2019) studied the Effect of flaxseed poultice compress application on pain and hand functions of patients with hand osteoarthritis. The study sample consisted of 82 patients who met the inclusion criteria in the Rheumatology Outpatient Clinic at a University Hospital between January 15, 2017, and May 15, 2018. Patients included in the sample groups were selected randomly. Three sample groups were formed: intervention group I

(flaxseed poultice compress) (n = 33), intervention group II (hot compress) (n = 29), and control group (n = 20). The interventions were applied once a day for 7 days in a row. These patients also continued their routine pharmacological treatment. descriptive characteristics identification form, visual analog scale (VAS), Australian-Canadian (AUSCAN) Osteoarthritis (OA) Hand Index, and side effect evaluation form were used as data collection tools. The present study showed that pain significantly decreased and the hand function efficiency increased in patients treated with flaxseed poultice compress compared with the hot compress and control groups. In addition to pharmacological treatment, flaxseed poultice compress intervention is recommended to be used as a nursing intervention for reducing pain and increasing hand functions for patients with hand OA in cooperation with the physicians and other health professionals.

Majdi Hashem et al. (2024) reported that impact of Neck and Shoulder Pain on Health-Related Quality of Life in Adults in Saudi Arabia. This is a cross-sectional study using an online-administered questionnaire that was distributed via online platforms in Saudi Arabia for the duration between January and June 2023. A total of 6601 participants were involved in this study. The majority of the participants (76.8%, n = 4610) reported that they had muscle tension, stiffness, pressure, or dull pain in the neck and shoulder area. Notwithstanding the participants' moderate evaluations of their current health and quality of life, certain demographic attributes - such as being male, being younger in age, being married, and having a lower body mass index - showed a favorable association with quality of life. Strict interventions and preventative measures are essential for addressing musculoskeletal issues in the neck and shoulder region, as indicated by these findings. Further research should be dedicated to developing tailored

interventions that specifically target different demographic cohorts, with the ultimate goal of improving the quality of life for all.

Gunnel Peterson and Nicklas Pihlstrom(2021) reported that factors associated with neck and shoulder pain: a cross-sectional study among 16,000 adults in five county councils in Sweden. This population-based, cross-sectional study was conducted in Sweden in 2017 and included 16,167 individuals, aged 18 to 63 years. We administered a questionnaire to determine neck and shoulder pain, the time spent in general physical activity or aerobic physical activity, the time spent sitting, sleep disturbances, general health, job satisfaction, and the time spent working. Factors associated with neck and shoulder pain were explored using logistic regression. Significant factors associated with neck and shoulder pain were: overall health, sleep quality, and aerobic exercise. The odds of sustaining neck and shoulder pain increased with moderate or poor health (odds ratios [ORs]: 2.3 and 2.8, respectively) and sleep disorders (OR: 1.7). Conversely, aerobic physical activity performed more than 60 min/week at a level that enhanced respiratory and heart rate was associated with a reduced risk of experiencing neck and shoulder pain (OR: 0.8).

Ismail H Almogbil (2023) Investigated the prevalence of neck and shoulder pain among healthcare workers in the Central Region of Saudi Arabia. An online survey was used, with 409 participants aged 20 or older. The questionnaire included socio-demographic data, a shoulder pain and disability index (SPADI) questionnaire to measure shoulder pain and disability, a neck Bournemouth questionnaire (NBQ) to assess neck pain, and a quadruple visual analog scale (QVAS) to measure the intensity of pain. The prevalence of high-intensity pain based on QVAS criteria was 29.3%. The mean percentage of neck pain (32.3%) was slightly higher than shoulder pain (31.8%).

There was a significant association between the level of pain intensity in terms of the total score of NBQ, SPADI score, and its dimensions. The prevalence of high-intensity pain based on QVAS criteria was 29.3%. The mean percentage of neck pain (32.3%) was slightly higher than shoulder pain (31.8%). There was a significant association between the level of pain intensity in terms of the total score of NBQ, SPADI score, and its dimensions.

Omar A Al-Mohrej et al.(2016) reported the Prevalence of musculoskeletal pain of the neck, upper extremities and lower back among dental practitioners working in Riyadh, Saudi Arabia: a cross-sectional study. Study aims to estimate the prevalence of MSK pain and investigate its associated risk factors among dentists in Saudi Arabia. Using random cluster sampling. 224 surveys were distributed among dentists with a 91.1% response rate (101 women and 103 men). 184 (90.2%) respondents reported having MSK pain. MSK pain is common among older and female Saudi dentists.

Ahmad Alghadir and Shahnawaz Anwer (2015) reported that prevalence of Musculoskeletal Pain in Construction Workers in Saudi Arabia. A questionnaire about musculoskeletal pain in different parts of the body was completed by 165 construction workers from the construction industries in Dammam and Riyadh cities. The descriptive data were analyzed using chi-square test. Eighty (48.5%) of the responding workers had pain in neck, shoulders, lower back, hand, knee, or ankle. It can be concluded from this study that the prevalence of musculoskeletal pain among construction workers in Saudi Arabia is high.

Conceptual Framework

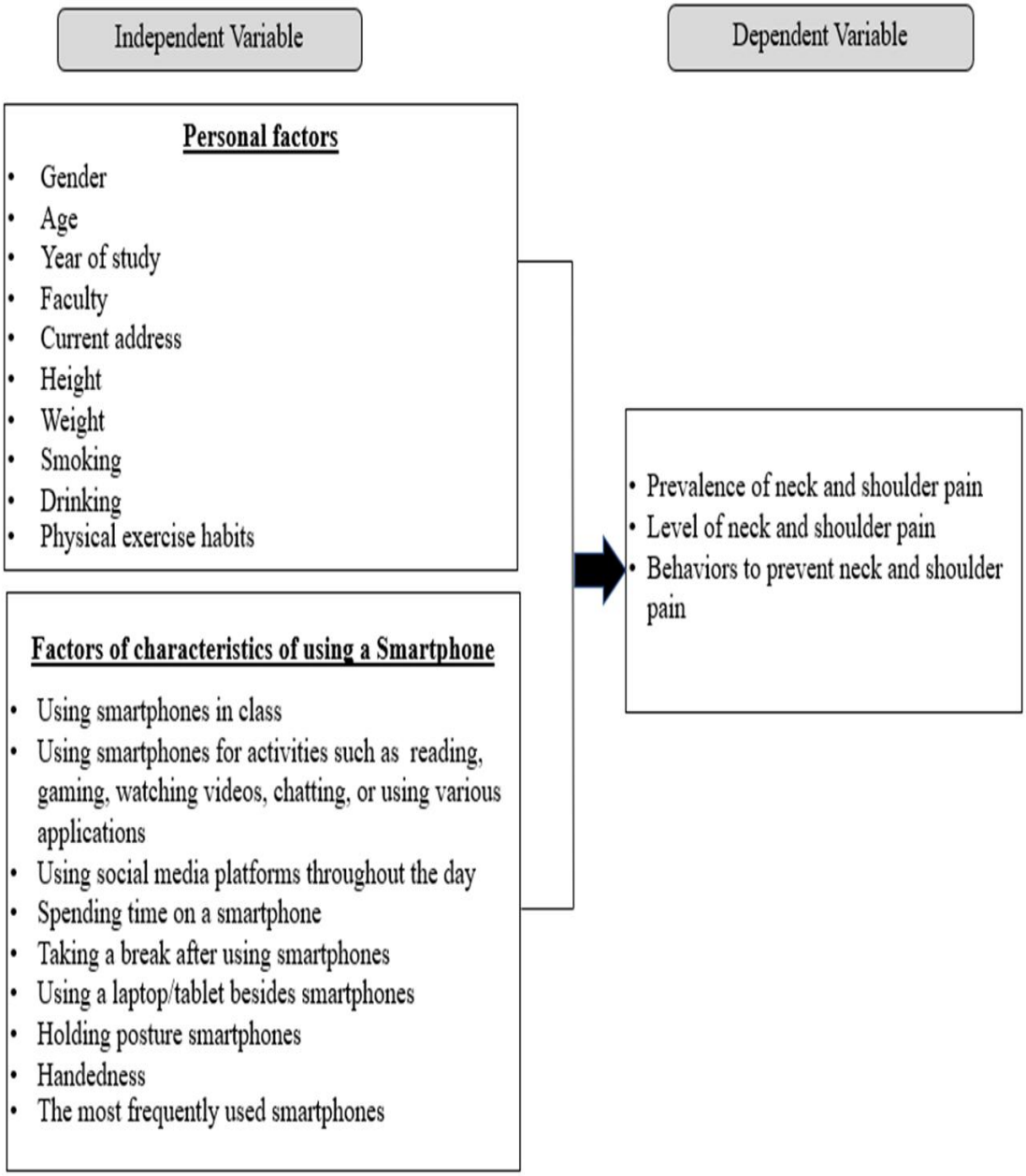


Figure 3 Conceptual Framework

CHAPTER III

RESEARCH METHODOLOGY

This chapter focuses on the behavior to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus. This study was divided into the following 8 parts;

1. Research design
2. Population and sample size
    2.1 Population
    2.2 Sample Size and Sampling Technique
    2.3 Inclusion Criteria
    2.4 Exclusion Criteria
3. Study area
4. Study period
5. Measurement instruments
6. Data collection
7. Data analysis

Research Design

The research design of this study was a cross-sectional descriptive study. All samples were collected at Hainan Vocational University of Science and Technology in Yunlong Campus

Population and Sample Size

Population

The population of this study consisted of 5 faculties at Hainan Vocational University of Science and Technology in Yunlong Campus, located in Haikou City, Hainan Province. The total student population was 14,187.

Sample Size and Sampling Technique

In this study, the population of 14,187 students in 5 faculties at Hainan Vocational University of Science and Technology in Yunlong Campus. Participants were recruited according to inclusion and exclusion criteria, and project information was obtained from the staff of Hainan Vocational University of Science and Technology. However, the dropout rate of researchers due to illness or inevitable unexpected circumstances is expected to be less than 10%. The sample size was calculated by the Taro Yamane formula（1967）, the eligible participants were 428 students.

$$n = \frac{N}{1 + N_{e^2}}$$

$$n = \frac{14187}{1+14187*(0.05)\text{^}2} \quad n\approx389$$

Error level=389×10%=38.9

Sample size=389+39=428

n = sample size (extract the sample size for 389 subjects)

N = population (14,187 students)

e = acceptable error level (0.05)

Then consider 10% sample attrition: 389×10=38.9≈39

Sample size：389+39=428

Table 1 Population and sample size

Faculty in University	Population (N)	Sample size (n)
Nursing care	5,955	180
Medicine	3,102	94
Urban construction	2,365	71
Accounting	2,021	61
Education and music	744	22
Total	**14,187**	**428**

Sampling Technique

This study used stratified sampling from 5 faculties at Hainan Vocational University of Science and Technology in Yunlong Campus, located in Haikou City, Hainan Province. According to the faculty where the students are located, the sample was divided into 5 groups. Among the 5,955 students in the faculty of Nursing care, 180 students were randomly selected as the sample size of the faculty of Nursing care, 94 students were randomly selected as the sample size of the faculty of Medicine, 71 students were randomly selected as the sample size of the faculty of Medicine, 2,365 students were randomly selected as the sample size of the faculty of Urban Construction,

61 students were randomly selected as the sample size of the faculty of Accounting, 744 students in the faculty of Education and Music, 22 students were randomly selected as the sample size of the faculty of Education and Music. The total student sample size of the 5 faculties was 428 students.

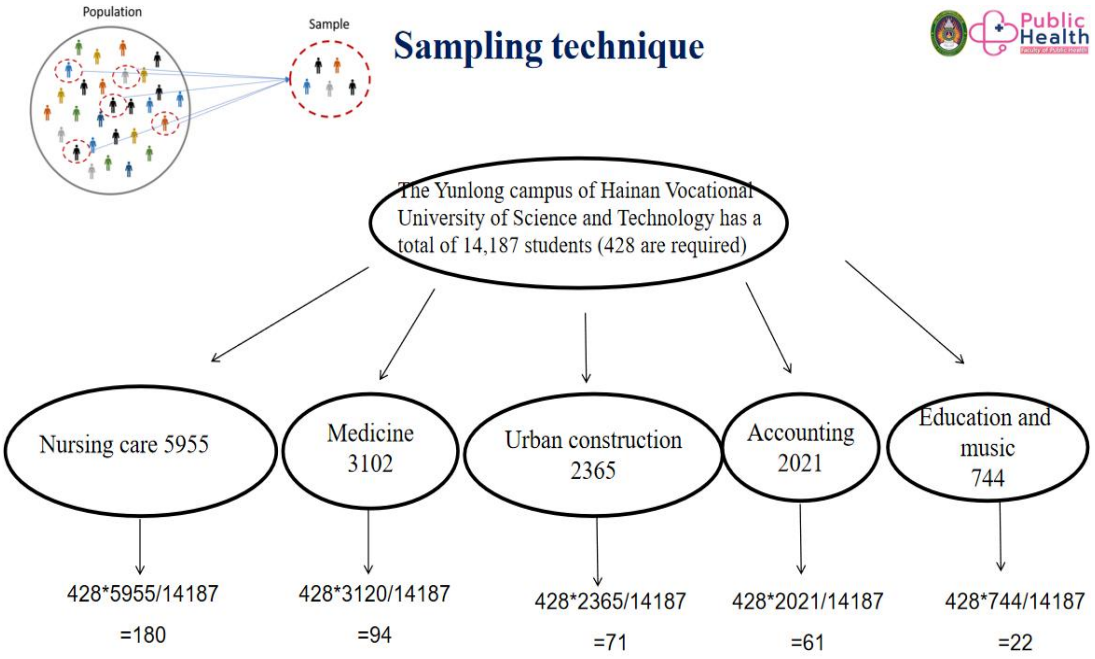


Figure 4 Sampling technique

Inclusion Criteria

1. Currently enrolled students at Hainan Vocational University of Science and Technology in Yunlong Campus.

2. Students had been using their smartphones

3. Volunteer to participate in research

Exclusion Criteria

1. Students who have experienced recent injuries or surgeries related to the neck or shoulders.

2. Students with a history of cervical spine disorders or chronic musculoskeletal diseases.

3. Students who are unable to complete the questionnaire fully or have missing essential information.

Study Area

This study was conducted at Hainan Vocational University of Science and Technology in Yunlong Campus, located in Hainan Province, southern China. The university consists of five academic faculties and accommodates a large number of college students. This location was selected because many students frequently use smartphones and tend to adopt improper postures during usage. Such behavior is likely to contribute to musculoskeletal problems, particularly neck and shoulder pain. Therefore, this campus provides an appropriate setting for studying preventive behaviors related to neck and shoulder pain among smartphone users.

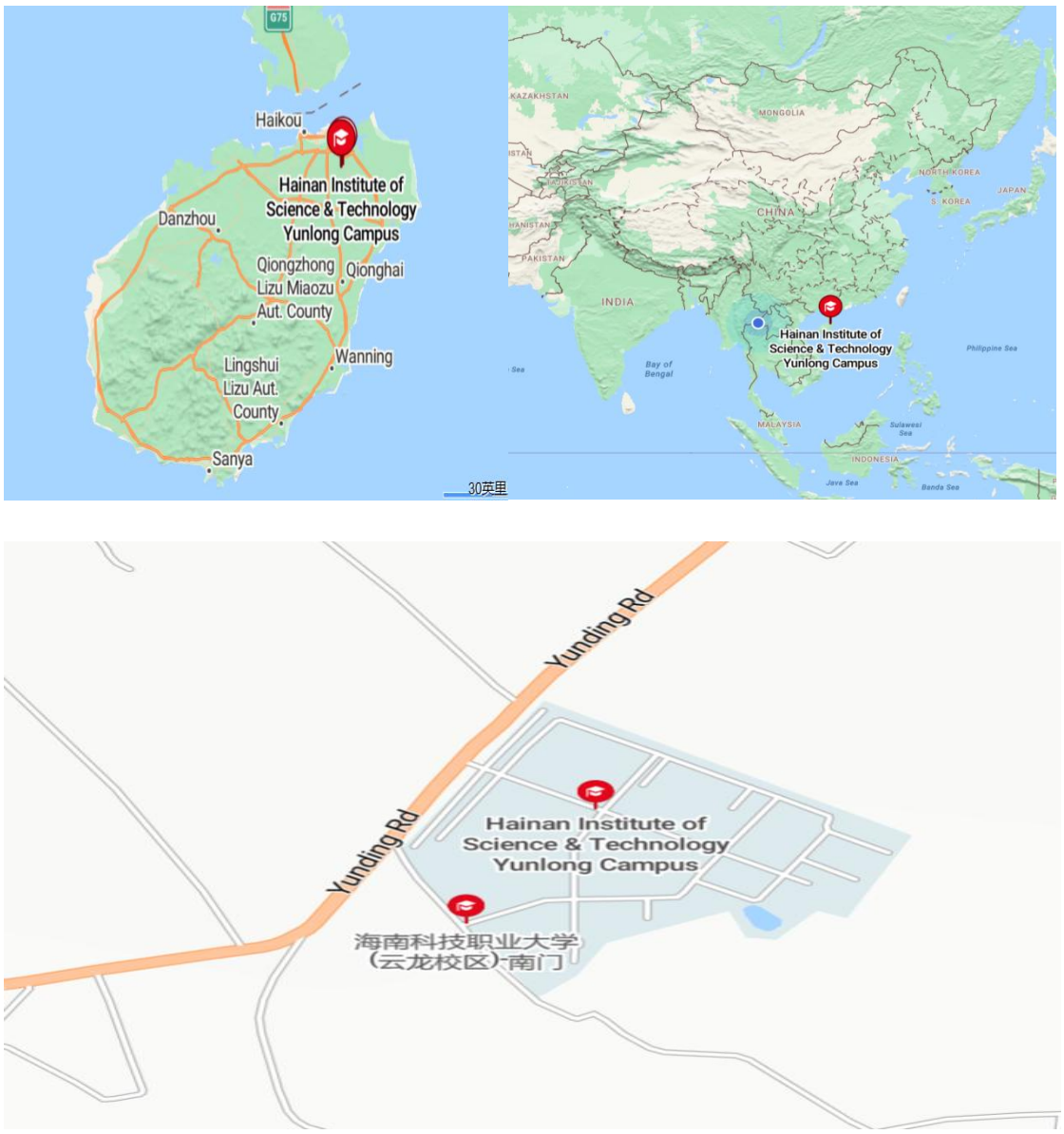


Figure 5 Map at Hainan Vocational University of Science and Technology in Yunlong campus (Google Map, 2024)

Study period

This study was conducted from August 2024 to March 2025.

Measurement instruments

Measurement Tool

This study employed an online questionnaire as the measurement tool for data collection. The questionnaire was divided into 4 parts as follows;

Part I: Personal factors

The questionnaire respondents included gender, age, year of study, faculty, current address, BMI (height, weight), smoking, drinking, and physical exercise habits.

Part II: Factors of characteristics of using a Smartphone

The study considered several factors related to smartphone usage behaviors, including: playing with a smartphone in class, using a smartphone for activities such as reading, gaming, watching videos, chatting, or using various applications, using social media platforms throughout the day, spending time on a smartphone, using a smartphone to do these activities, using a laptop/tablet besides a smartphone, holding a smartphone, handedness, and the most frequently used smartphones.

Part III: Musculoskeletal Discomfort Assessment (MSDA)

The questionnaire applies to Musculoskeletal Discomfort Assessment (MSDA) In this paper, according to the requirements of the study using a modified. (Kanjanar Pintakhham and Wattasit Siriwong,2016). The questionnaire was created

with anatomical regions of the human body and the map diagram of the body was divided into 2 regions including neck and shoulder.

1. The prevalence rate of neck and shoulder pain will be computed as follows;

$$\text{neck and shoulder rate} = \frac{\text{all new and pre-existing cases during a time period}}{\text{Population during the same period}} \times 100$$

2. Neck and shoulder were modified pain scale by numeric rating scale, a scale from 0 to 10 where 0 is no pain and 10 is more pain as follows;

No pain----------More pain

0 1 2 3 4 5 6 7 8 9 10

The neck and shoulder pain cut-off score ≥ 4, the data indicated the mean score of musculoskeletal discomfort, and it was indicated the risk level as follows;

Table 2 The risk of musculoskeletal discomfort rating level

Levels	**Severity of neck and shoulder pain levels**
0.00-0.99	No neck and shoulder pain
1.00-3.99	Slight neck and shoulder pain
4.00-6.99	Moderate neck and shoulder pain
7.00-9.99	High neck and shoulder pain
10	Severe neck and shoulder pain

Source: (Kanjanar Pintakhham and Wattasit Siriwong,2016)

Part IV: Behaviors to prevent neck and shoulder pain

The behaviors to prevent the occurrence of neck and shoulder pain included 4 rating scales, such as

Always	means practice every day	4 scores
Often	means Practice 4-6 days per week	3 scores
Sometimes	means Practice 1-3 days per week	2 scores
Never	means practice	1 score

The criteria for finding the average of the results using the formula of the width in the class interval are as follows (Panchakarma Pothibenjakul, 2007: 67)

From the formula, the width of the class interval $= \frac{\text{highest value - lowest value}}{\text{Number of classes}}$

$= \frac{4-1}{4} = 0.75$

$= 4$

The criteria for preventing neck and shoulder pain behavior level are divided into 4 levels using the average score as follows:

An average score of 3.28 - 4.00 means very good behavior

An average score of 2.52 - 3.27 means good behavior

An average score of 1.76 - 2.51 means adequate behavior

An average score of 1.00 - 1.75 means low behavior

Tool development process

1. Research literature, including literature related to the research, to optimize the research questionnaire.

2. Consult the supervisor's research questionnaire

3. Submit the questionnaire to three experts for evaluation

4. Modify the questionnaire according to expert suggestions. The above is appropriate

5. Conduct sample tests in the study area

Research tool quality

The accuracy of the study content requires the expert to believe that the research question is determined to meet the measured content or the purpose of the study

A score of +1 means to be certain of the content/purpose of the question.

A score of 0 means being uncertain about the content/purpose of the question.

A score of -1 means to identify an issue without measuring its content/purpose

index of item-objective congruence IOC

According to the formula:

$$\mathrm{IOC} = \Sigma \mathrm{R}/\mathrm{N}$$

R stands for the sum of expert reviews.

N represents the number of majors

If the IOC criterion is 0.05 or above, then the problem is objective

Reliability

The modified questionnaire was pre-tested on a group of 30 students who met the criteria of the target population. The questionnaire was put in the area for a tryout at Zhengzhou University. The data collected from this pilot test were analyzed to determine the reliability of the instrument. The section measuring musculoskeletal discomfort assessment demonstrated a Cronbach' s alpha coefficient of 0. 754 and behaviors to prevent neck and shoulder pain demonstrated a Cronbach' s alpha coefficient of 0.911, indicating excellent internal consistency and confirming the tool's appropriateness for use among students at Hainan Vocational University of Science and Technology in Yunlong Campus.

Data collection

In this researcher will follow these steps to collect data

1. Request a letter of certification from I- SEM, Chiang Rai Rajabhat University, to authorize the data collection process.

2. Coordinate with the relevant areas to conduct the data collection using the questionnaire.

3. Collect data using the questionnaire by coordinating with the heads of departments to schedule dates for data collection from the sample groups of each college.

4. The questionnaire used for data collection has been validated by three experts with a validity score of more than 0. 5, and its reliability has been calculated

from a sample group similar to the target population of the research, consisting of 30 individuals, with a reliability score of more than 0.7.

5. Collect data from the target sample group of the research, which consists of 428 individuals

Data analysis

The descriptive statistics analyzed the personal factors prevalence, level of neck and shoulder pain, and behavior to prevent neck and shoulder pain among students at Hainan Vocational University of Science and Technology, Yunlong Campus, were frequencies, percentages, mean, and standard deviation.

CHAPTER IV

RESULTS

This chapter aims to study the prevalence and level of neck and shoulder pain, as well as assess behaviors to prevent neck and shoulder pain among smartphone-using students at Hainan Vocational University of Science and Technology in Yunlong Campus, Haikou City, Hainan Province.

1. Personal factors
2. Factors of characteristics of using a Smartphone
3. Prevalence and level of neck and shoulder pain
4. Behavior to prevent neck and shoulder pain
5. Association analysis between personal factors and behaviors to prevent neck and shoulder pain among students of smartphone users

Personal factors.

Table 3 Frequency and percentage of students by gender (n=428)

Gender	Number (n=428)	Percentage (%)
Male	143	33.41
Female	285	66.59
Total	**428**	**100.00**

Table 3 shows the frequency and percentage of students by gender. The majority of students were female, with a total of 285 students (66.59%), while 143 students (33.41%) were male.

Table 4 Frequency and percentage of students by age (n=428)

Age (Years)	Number (n=428)	Percentage (%)
19	105	24.53
20	108	25.23
21	111	25.94
22	104	24.30
Mean=20.50 Minimum =19 Maximum=22		
Total	**428**	**100.00**

Table 4 shows the frequency and percentage of students by age. The average age was 21 years, with a range from 19 to 22 years. The majority of students were 21 years old, totaling 111 students (25.90%), followed by 108 students (25.20%) aged 20 years and the smallest group consisted of students aged 22 years, totaling 104 students (24.30%).

Table 5 Frequency and percentage of students by year of study (n=428)

Year of study	Number (n=428)	Percentage (%)
year 1	88	20.56
year 2	125	29.21
year 3	128	29.91
year 4	87	20.33
Total	**428**	**100.00**

Table 5 shows the frequency and percentage of students by year of study. The majority were third-year students, totaling 128 students (29.90%), followed by second-year students with 125 students (29.20%), and the smallest group consisted of fourth-year students, totaling 87 students (20.30%).

Table 6 Frequency and percentage of student-faculty (n=428)

Faculty	Number (n=428)	Percentage (%)
Medicine	94	21.96
Nursing	180	42.06
Accountancy	61	14.25
Urban Construction	71	16.59
Education and Music	22	5.14
Total	**428**	**100.00**

Table 6 shows the frequency and percentage of student-faculty. The majority of students were from the nursing faculty, totaling 180 students (42.06%), followed by the medicine faculty with 94 students (21.96%), and the least was from the education and music Faculty, totaling 22 students (5.14%).

Table 7 Frequency and percentage of students by address (n=428)

Address	Number (n=428)	Percentage (%)
City	305	71.26
Village	123	28.74
Total	**428**	**100.00**

Table 7 shows the frequency and percentage of students by address. The majority of students were from the city, with a total of 305 students (71.26%), while 123 students (28.74%) were from the village.

Table 8 Frequency and percentage of students by height (n=428)

Height(cm)	Number (n=428)	Percentage (%)
155-161	89	20.79
162-168	86	20.10
169-175	171	39.95
179-180	82	19.16
Total	**428**	**100.00**

Table 8 shows the frequency and percentage of students by height. The majority were 169-175cm, totaling 171 students (39.95%), followed by 155-161 cm with 89 students (20.79%), and the least was 179-180 cm, totaling 82 students (19.16%).

Table 9 Frequency and percentage of students by weight (n=428)

Weight(kg)	Number (n=428)	Percentage (%)
50-58	176	41.12
59-67	123	28.74
68-76	129	30.14
Total	**428**	**100.00**

Table 9 shows the frequency and percentage of students by weight. The majority were 50-58 kg, totaling 176 students (41.12%), followed by 68-76 kg with 129 students (30.14%), and the least was 59-67 kg, totaling 123 students (28.74%).

Table 10 Frequency and percentage of students by smoke (n=428)

Smoke	Number (n=428)	Percentage (%)
No	168	39.25
Yes	260	60.75
Total	**428**	**100.00**

Table 10 shows the frequency and percentage of students by smoke. The majority of students smoked, with a total of 260 students (60.75%), while 168 students (39.25%) did not smoke.

Table 11 Frequency and percentage of students by drink (n=428)

Drink	Number (n=428)	Percentage (%)
No	130	30.37
Yes	298	69.63
Total	**428**	**100.00**

Table 11 shows the frequency and percentage of students by drink. The majority of students drank, with a total of 298 students (69.63%), while 130 students (30.27%) did not drink.

Table 12 Frequency and percentage of students' physical exercise habits (n=428)

Physical exercise habit	Number (n=428)	Percentage (%)
No	249	58.18
Yes	179	41.82
Total	**428**	**100.00**

Table 12 shows the frequency and percentage of students' physical exercise habits. The majority of students had without physical exercise habits, with a total of 249 students (58.18%), while 179 students (41.82%) had physical exercise habits.

Factors of characteristics of using a smartphone

Table 13 Frequency and percentage of playing smartphones in class (n=428)

Played	**Number (n=428)**	**Percentage (%)**
Never	32	7.48
Occasionally	126	29.44
Always	270	63.08
Total	**428**	**100.00**

Table 13 shows the frequency and percentage of playing smartphones in class； the majority always played smartphones, totaling 270 students (63.08%), followed by occasionally playing smartphones with 126 students (29.44%), and the least never played smartphones, totaling 32 students (7.48%).

Table 14 Frequency and percentage of those who use smartphone every day to read,play games,watch videos,chat,or other software (n=428)

Used	Number (n=428)	Percentage (%)
No	86	20.09
Yes	342	79.91
Total	**428**	**100.00**

Table 14 shows the frequency and percentage of those who use smartphone every day to read,play games,watch videos,chat,or other software. The majority of students were used, with a total of 342 students (79.91%), while 86 students (20.09%) were not used.

Table 15 Frequency and percentage of use of social media platforms(n=428)

Software	Number (n=428)	Percentage (%)
One	54	12.62
Two	115	26.87
Three	170	39.72
More than four	89	20.79
Total	**428**	**100.00**

Table 15 shows the frequency and percentage of use of social media platforms. The majority use three social media platforms, totaling 170 students (39.72%), followed by the use of two social media platforms with 115 students (26.87%), and the least use one social media platform, totaling 54 students (12.62%).

Table 16 Frequency and percentage use of smartphones time(n=428)

Time (Hr)	**Number (n=428)**	**Percentage (%)**
2-3	98	22.90
4-5	133	31.08
6-7	108	25.23
8-9	89	20.79
Mean=5.39 Minimum =2 Maximum=9		
Total	**428**	**100.00**

Table 16 shows the frequency and percentage use of smartphones time. The average time was 5.39 hours, with a range from 2 to 9 hours. The majority were 4-5 hrs., totaling 133 students (31.07%), followed by 6-7 hrs. with 108 students (25.23%), and the least was 8-9 hrs., totaling 89 students (20.79%).

Table 17 Frequency and percentage of taking a break from using your smartphones (n=428)

Break	Number (n=428)	Percentage (%)
No	352	82.24
Yes	76	17.76
Total	**428**	**100.00**

Table 17 shows the frequency and percentage of taking a break from using your smartphones. The majority of students were on break, with a total of 352 students (82.24%), while 76 students (17.76%) were not on break.

Table 18 Frequency and percentage of using a laptop/tablet (n=428)

Still (use of a laptop/tablet)	Number (n=428)	Percentage (%)
No	78	18.22
Yes	350	81.78
Total	**428**	**100.00**

Table 18 shows the frequency and percentage ofusing a laptop/tablet. The majority of students were used a laptop/tablet, with a total of 350 students (81.78%), while 78 students (18.22%) did not use a laptop/tablet.

Table 19 Frequency and percentage posture of holding a smartphones (n=428)

Hold	Number (n=428)	Percentage (%)
Below eye level	258	60.28
At eye level	78	18.22
Above eye level	92	21.50
Total	**428**	**100.00**

Table 19 shows the frequency and percentage posture of holding a smartphones. The majority were below eye level, totaling 258 students (60.28%), followed by above eye level with 92 students (21.50%), and the least was at eye level, totaling 78 students (18.22%).

Table 20 Frequency and percentage of handedness (n=428)

Handedness	Number (n=428)	Percentage (%)
Right-handed	132	30.84
Left-handed	81	18.93
Both-handed	215	50.23
Total	**428**	**100.00**

Table 20 shows the frequency and percentage of handedness. The majority were both-handed, totaling 215 students (50.23%), followed by right-handed with 132 students (30.84%), and the least was left-handed, totaling 81 students (18.93%).

Table 21 Frequency and percentage of the most frequently used activities on smartphones (n=428)

Activities	Number (n=428)	Percentage (%)
Scheduling work	28	6.54
Talking on the phone	36	8.41
Listening to music	60	14.02
Watching videos	140	32.71
Send and receive messages	35	8.18
Play games	129	30.14
Total	**428**	**100.00**

Table 21 shows the frequency and percentage of the most frequently used activities on smartphones. The majority were watching videos, totaling 140 students (32.71%), followed by playing games with 129 students (30.14%), and the least was scheduling work, totaling 28 students (6.54%).

Prevalence and level of neck and shoulder pain

Table 22 Frequency and percentage of muscle pain in the past month is classified by body par (n=428)

Body part	No		Yes	
	Number (n=428)	**Percentage (%)**	**Number (n=428)**	**Percentage (%)**
Neck	82	19.16	346	80.84
Right Shoulder	150	35.05	278	64.95
Left Shoulder	190	44.39	238	55.61

Table 22 shows the frequency and percentage of muscle pain in the past month is classified by body par. A high prevalence of neck pain was reported by 80.84% of students, while 64.95% experienced pain in the right shoulder and 55.61% in the left shoulder.

Table 23 Mean, std.deviation, and level of muscle pain in the past month (n=428)

Body part	Mean	±SD	Level
Neck	4.46	2.44	Moderate
Right Shoulder	3.66	2.90	Slight
Left Shoulder	3.04	2.89	Slight

Table 23 shows the mean, std.deviation, and level of muscle pain in the past month. The neck had the highest average pain level (4.46±2.44), categorized as moderate. Both the right shoulder (3.66± 2.90) and left shoulder (3.04±2.89) were classified as experiencing slight pain.

Table 24 Frequency and percentage of level of neck and shoulder pain (n=428)

Pain level	Neck		Right shoulder		Left shoulder	
	Number (n=428)	**Percentage (%)**	**Number (n=428)**	**Percentage (%)**	**Number (n=428)**	**Percentage (%)**
No neck and shoulder pain	82	19.20	150	35.00	191	44.60
Slight neck and shoulder pain	10	2.30	6	1.40	9	2.10
Moderate neck and shoulder pain	279	65.20	215	50.20	190	44.40
High neck and shoulder pain	53	12.40	50	11.70	36	8.20
Severe neck and shoulder pain	4	0.90	7	1.60	3	0.70
Total	**428**	**100.00**	**428**	**100.00**	**428**	**100.00**

Table 24 shows the frequency and percentage of the level of neck and shoulder pain. The majority had moderate neck and shoulder pain, with 65.20% of respondents reporting neck pain, 50.20% reporting right shoulder pain, and 44.40% in left shoulder pain.

Behaviors to prevent neck and shoulder pain

Table 25 Mean, std.deviation, and level scores for behaviors that prevent neck and shoulder pain (n=428)

Behaviors to prevent neck and shoulder pain	Mean	SD	Level
1. You should avoid using your smartphone continuously for 20 minutes to prevent neck and shoulder pain.	3.19	0.77	Good
2. You avoid bending your neck while using your smartphone to reduce the risk of neck and shoulder pain.	3.22	0.76	Good
3. You avoid elevating your smartphone above your shoulder to reduce the risk of neck and shoulder pain.	3.17	0.74	Good
4. You avoid holding your smartphone on your lap, to prevent bending your neck	3.15	0.76	Good
5. You avoid sleeping on your side and using your smartphone because you have to tilt your head and lift one shoulder.	3.16	0.76	Good

Table 25 (Continued)

Behaviors to prevent neck and shoulder pain	Mean	SD	Level
6. You stretch your muscles when you have neck and shoulder pain	3.17	0.77	Good
7. You study information about preventing muscle pain from using a smartphone to prevent neck and shoulder pain.	3.17	0.81	Good
8. You use hot compresses when you have neck and shoulder pain.	3.13	0.78	Good
9. You take pain relievers or muscle relaxants because you use your smartphone	3.18	0.78	Good
Average total	**3.17**	**0.77**	**Good**

Table 25 shows the mean, std.deviation, and level scores for behaviors that prevent neck and shoulder pain. The overall mean score for behaviors to prevent neck and shoulder pain was found to be at a good level (3.22 ± 0.76). When considering each item individually, all questions had mean scores at a good level. The highest mean score was found in item 2: "You avoid bending your neck while using your smartphone to reduce the risk of neck and shoulder pain" (3.22 ± 0.76), followed by item 1: "You should avoid using your smartphone continuously for 20 minutes to prevent neck and shoulder pain" (3.19 ± 0.77). The lowest mean score was in item 8: "You use hot compresses when you have neck and shoulder pain" (3.13 ± 0.78).

Table 26 Frequency and percentage of level behaviors to prevent neck and shoulder pain (n=428)

Level behaviors	Number (n=428)	Percentage (%)
Low behavior	44	10.30
Adequate behavior	9	2.10
Good behavior	83	19.40
Very good behavior	292	68.20
Total	**428**	**100.00**

Table 26 shows the frequency and percentage of level behaviors to prevent neck and shoulder pain. The majority had very good behavior, totaling 292 students (68.20%), followed by good behavior with 83 students (19.40%), and the least was adequate behavior, totaling 9 students (2.10%).

Association analysis between personal factors and behaviors to prevent neck and shoulder pain among students of smartphone users.

Table 27 The relationship between gender associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Gender	Male	14(9.79%)	129(90.21%)	143(100%)	0.279
	Female	39(13.68%)	246(86.32%)	285(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 27 shows no statistically significant association between gernder group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 28 The relationship between age associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Age （Years)	≥21	27(8.33%)	297(91.67%)	324(100%)	<0.001**
	22≤	26(25.00%)	78(75.00%)	104(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 28 shows statistically significant association between age group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 29 The relationship between year of study associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Year of study	Year 1-3	28(8.21%)	313(91.79%)	341(100%)	<0.001**
	Year 4	25(28.74%)	62(71.26%)	87(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 29 shows a statistically significant association between the year of study group and behaviors to prevent neck and shoulder pain, p< 0.05.

Table 30 The relationship between faculty associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain			
		Low and adequate behavior n（%）	**Good and very good behavior n（%）**	**Total n（%）**	**P-value**
Faculty	Medicine, Nursing and Accountancy faculty	33(12.04%)	241(87.96%)	274(100%)	0.762
	Urban Construction and Education and Music	20(12.99%)	134(87.01%)	154(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 30 shows no statistically significant association between faculty group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 31 The relationship between address associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Address	City	39(12.79%)	266(87.21%)	305(100%)	0.748
	Village	14(11.38%)	109(88.62%)	123(100%)	

* significant at p-value < 0.05, Fisher's Exact Test

Table 31 shows no statistically significant association between address group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 32 The relationship between height(cm) associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Height(cm)	155-168	23(13.14%)	152(86.86%)	175(100%)	0.766
	169-180	30(11.86%)	223(88.14%)	253(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 32 shows no statistically significant association between height(cm) group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 33 The relationship between weight(cm) associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Weight(kg)	50-63	29(13.24%)	190(86.76%)	219(100%)	0.660
	64-76	24(11.48%)	185(88.52%)	209(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 33 shows no statistically significant association between weight(cm) group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 34 The relationship between smoke associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Smoke	No	19(11.31%)	149(88.69%)	168(100%)	0.653
	Yes	34(13.08%)	226(86.92%)	260(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 34 shows no statistically significant association between smoke group and behaviors to prevent neck and shoulder pain p< 0.05.

Table 35 The relationship between drink associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain		Total n（%）	P-value
		Low and adequate behavior n（%）	Good and very good behavior n（%）		
Drink	No	15(11.54%)	115(88.46%)	130(100%)	0.873
	Yes	38(12.75%)	260(87.25%)	298(100%)	

*significant at p-value < 0.05, Fisher's Exact Test

Table 35 shows no statistically significant association between drink group and behaviors to prevent neck and shoulder pain, p< 0.05.

Table 36 The relationship between physical exercise habits associated with behaviors to prevent neck and shoulder pain.

Personal factors		behaviors to prevent neck and shoulder pain			P-value
		Low and adequate behavior n（%）	**Good and very good behavior n（%）**	**Total n（%）**	
Physical exercise habit	No	31(12.45%)	218(87.55%)	249(100%)	1.000
	Yes	22(12.29%)	157(87.71%)	179(100%)	

*Significant at p-value < 0.05, Fisher's Exact Test

Table 36 shows no statistically significant association between physical exercise habit group and behaviors to prevent neck and shoulder pain p< 0.05

CHAPTER V

CONCLUSION AND DISCUSSIONS

The title of the study was behavior to prevention of neck and shoulder pain among student smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus. This study aims to study the prevalence, level of neck and shoulder pain, and assess behavior to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong Campus. The study population consisted of 428 students, and the sample size was determined using Taro Yamane's formula, selected through simple random sampling. The study utilized a structured questionnaire, which comprised the following sections: section 1: personal factors, section 2: factors of characteristics of using a smartphone, section 3: musculoskeletal discomfort assessment (MSDA), and section 4: behaviors to prevent neck and shoulder pain. Data were analyzed using statistical software, employing the following statistical methods: frequency distribution, percentage, mean, and standard deviation. The research findings are structured as follows:

1. Conclusion
2. Discussion of results
3. Research generalizability
4. Recommendation for further research

Conclusion

1. Personal data analysis

The majority of students were female Most are female (66.59%), the average age was 20.50 years, with a range from 19 to 22 years age, the third-year year of study (29.90%), and nursing faculty (42.06%). The majority of students were from the city (71.26%), height was 169-178cm (48.76%), weight was 50-58kg (41.12%), smoking (60.75%), drinking (69.63%), and without physical exercise habits (58.18%)

2. Factors of characteristics of using a smartphone

The majority always played smartphones in class (63.08%), using smartphones for activities such as reading, gaming, watching videos, chatting, or using various applications (79.91%), using social media platforms throughout the day 3 software (39.72%), spending time on smartphones 4-5 hours daily (31.07%), not taking a break after using smartphones (82.24%), using a laptop/tablet besides smartphones (81.78%), holding posture smartphones below eye level (60.28%), handedness were both-handed (50.23%), and the most frequently used smartphones watched videos (32.71%).

3. Prevalence and level of neck and shoulder pain

The prevalence of neck and shoulder pain in the past month. A high prevalence of neck pain was reported by 80.84% of students, while 64.95% experienced pain in the right shoulder and 55.61% in the left shoulder. The level of neck and shoulder pain in the past month. The neck had the highest average pain level (4.46±2.44), categorized as moderate. Both the right shoulder (3.66± 2.90) and left shoulder (3.04±2.89) were classified as experiencing slight pain.

4. Behaviors to prevent neck and shoulder pain

The overall mean score for behaviors to prevent neck and shoulder pain was found to be at a good level (3.22 ± 0.76). When considering each item individually, all questions had mean scores at a good level. The highest mean score was found in item 2: “You avoid bending your neck while using your smartphone to reduce the risk of neck and shoulder pain” (3.22 ± 0.76), followed by item 1: “You should avoid using your smartphone continuously for 20 minutes to prevent neck and shoulder pain” (3.19 ± 0.77). The lowest mean score was in item 8: “You use hot compresses when you have neck and shoulder pain” (3.13 ± 0.78).

5. Personal factors and behaviors to prevent neck and shoulder pain among students of smartphone users

The personal factors associated behaviors to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology university was found that association between age and year of study significant ($P<0.05$).

Discussion of results

The prevalence of neck and shoulder pain in the past month showed highest prevalence was observed in neck pain, reported by 80.84% of students, followed by pain in the right shoulder (64.95%) and left shoulder (55.61%). These findings are consistent with previous studies indicating that prolonged smartphone use is associated with musculoskeletal discomfort, particularly in the neck and upper shoulder regions (Kim and Kim, 2015; Gustafsson et al., 2017). The repetitive use of smartphones, often

in non-ergonomic postures such as bending the neck forward or holding the phone at chest level, significantly contributes to muscular strain and postural fatigue. This finding aligns with a study conducted in Saudi Arabia, which reported a neck pain prevalence of 71.2% among smartphone users (Bader Alzarea and Santosh R Patil, 2015). However, other studies have shown varying prevalence rates. For instance, our study reported a higher prevalence of neck pain (80.84%) compared to previous studies in Singapore (74%), Saudi Arabia (71.2%), and Brazil (66.7%). The differences in prevalence rates observed across these studies may be attributed to various factors, including 1) duration and frequency of smartphone use because prolonged and frequent smartphone usage increases strain on the neck and shoulder muscles, especially when used continuously without adequate rest, 2) posture while using smartphones because poor posture, such as bending the neck forward, slouching, or holding the phone at waist or lap level, places excessive pressure on the cervical spine and shoulder muscles, 3) lack of physical activity because sedentary lifestyles and insufficient physical activity can lead to muscle stiffness and reduced flexibility, increasing the risk of musculoskeletal discomfort, 4) study habits and academic demands because students often use smartphones for academic purposes such as reading articles, completing assignments, or watching lectures. long hours of academic engagement through screens can contribute to musculoskeletal strain, and 5) device characteristics, the size, weight, and type of smartphone can also affect posture and hand positioning, which in turn impacts the neck and shoulder muscles. These factors interact in complex ways and may vary from one individual to another, leading to different levels of musculoskeletal pain among students. Moreover, the increasing prevalence of smartphone use may also contribute to the observed differences. With the growing penetration of smartphones in

daily life, students are exposed to prolonged usage not only for social interaction but also for academic purposes. The use of electronic devices for assignments, online learning materials, and study- related videos has become more common, thereby increasing screen time and associated musculoskeletal strain. A longitudinal prospective study conducted in Singapore by Siao Hui Toh et al. (2020) examined the distribution of musculoskeletal symptoms in the neck and shoulders among primary and secondary school students who regularly used tablets and smartphones. The study found a high prevalence of neck and shoulder discomfort, reinforcing the notion that increased use of handheld devices is a significant contributing factor to musculoskeletal pain.

The level of neck and shoulder pain in the past month. The neck had the highest average pain level (4.46±2.44), categorized as moderate. Both the right shoulder (3.66±2.90) and left shoulder (3.04±2.89) were classified as experiencing slight pain. These findings are consistent with previous studies indicating that among the dentists working in Riyadh, Saudi Arabia (64.3%), the intensity of neck pain was moderate (Omar A Al-Mohrej et al., 2016). Similarly, in Sweden, 49.5% of the participants suffered from mild or severe neck or shoulder pain (Gunnel Peterson and Nicklas Pihlstrom, 2021). There is muscle tension, stiffness, pressure, or dull pain in the shoulder and neck area. The average pain level is mild. No serious problems in the shoulder and neck region have occurred (Majdi Harlem et al., 2024).The reasons for the observed pain characteristics in the student may be attributed to various factors, including 1) the highest pain intensity was in the neck, likely due to sustained forward head posture during work, increasing mechanical load on cervical vertebrae and muscles of trapezius and levator scapulae,2) the right shoulder exhibited slightly higher pain than the left, possibly due to asymmetrical tool use and muscle overuse in

dominant-side stabilization,3) the reported tension and stiffness suggest myofascial pain syndrome, where trigger points develop from prolonged muscle contraction without adequate rest. There are also many ways to relieve pain, including 1) modifying workstation setup (e.g., adjusting chair height, using loupes to reduce neck flexion, and ensuring arm support) can decrease strain,2) strengthening deep cervical flexors and scapular stabilizers (e.g., chin tucks, scapular retractions) improves posture and reduces muscle fatigue,3) implementing brief pauses every 20-30 minutes for gentle neck/shoulder stretches can prevent stiffness accumulation,4) heat therapy, massage, or dry needling may relieve muscle tension if conservative methods are insufficient

The overall mean score for behaviors to prevent neck and shoulder pain was found to be at a good level (3.22 ± 0.76). When considering each item individually, all questions had mean scores at a good level. The highest mean score was found in item 2: “You avoid bending your neck while using your smartphone to reduce the risk of neck and shoulder pain” (3.22 ± 0.76), followed by item 1: “You should avoid using your smartphone continuously for 20 minutes to prevent neck and shoulder pain” (3.19 ± 0.77). The lowest mean score was in item 8: “You use hot compresses when you have neck and shoulder pain” (3.13 ± 0.78). The potential reasons for the good level of overall preventive behavior may be attributed to various factors, including 1) In recent years, with the popularity of smartphones and sedentary lifestyles, studies on shoulder and neck pain have increased, and related health education has gradually become widespread. For instance, research indicates that the duration of daily work-related usage is an important risk factor for musculoskeletal symptoms (Krain Lindgren Griffiths et al., 2012). There is a significant relationship between an individual's posture and neck pain, and improper postures in the head and neck region are more common in

the symptomatic group (Parena Negative et al., 2014). The longer one works with their head down, the higher the risk of developing neck and shoulder pain (Ansu Want et al., 2024). This may prompt more people to take preventive measures actively. Moreover, through hospital-based public education on knowledge dissemination and interesting exercises, it can effectively improve patients' behavioral compliance,2) Because surgeons (89.2%) constantly lower their heads and bend their necks (Omar A Al-Mohrej, MD et al., 2020). In this study, the item with the highest score was avoiding using mobile phones with head down, and the item with a higher score was limiting the continuous usage time, which are behaviors with relatively strong daily operability. However, the item with a lower score was hot compress, although hot compress can effectively improve functional performance by dilating capillaries, promoting blood circulation and releasing muscle tension Burcu Babadag Savas, Guler Balci Alparslan and Cengiz Korkmaz(2019). this behavior is more medical professional. What the general public may know is that hot compress is a measure to relieve pain after the occurrence of pain.

The personal factors associated behaviors to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology was found that association between age and year of study significant ($P<0.05$). As individuals age, engagement in preventive behaviors for neck and shoulder pain—such as taking breaks during smartphone use or correcting posture—tends to decline. This negative correlation can be attributed to several age-related factors. Firstly, executive function, which governs self-regulation, planning, and sustained attention, often diminishes with age (Ceolini et al., 2024). As a result, older individuals may struggle to consistently implement health-promoting behaviors, even

if they are aware of them. Secondly, motor function declines with aging, including reduced strength, flexibility, and coordination (Wunderle et al., 2024), making it more physically challenging to perform posture adjustments or mobility-based interventions. Additionally, ingrained behavioral habits formed over time can create inertia, reducing the likelihood of adopting new preventive practices. Lastly, older adults may prioritize other health concerns perceived as more urgent, leading to reduced attention to musculoskeletal self-care. Together, these cognitive, physical, and behavioral factors help explain why preventive behavior decreases with age, despite awareness of its importance.

Research generalizability

1. The findings offer reference value for similar educational contexts (e.g., vocational colleges, undergraduate institutions) with potential scalability across regions and populations.

2. The methodology establishes an adaptable framework for investigating health issues particularly occupational-related musculoskeletal concerns or diverse student groups.

3. Identified neck-shoulder pain prevention strategies demonstrate cross-application potential across educational stages and occupational fields, providing actionable insights for comprehensive health guidelines.

Recommendation for further research

1. Conduct longitudinal or experimental studies to better understand the causal relationship between smartphone usage and musculoskeletal pain, future research should consider using longitudinal or experimental designs.

2. Expand the population scope include participants from multiple universities, different age groups, or various academic programs to increase the generalizability of the findings.

3. Evaluate intervention strategies in future studies should explore the effectiveness of interventions such as ergonomic education, posture correction exercises, or the use of mobile applications that promote healthy usage habits

REFERENCE

Alghadir, A., & Anwer, S. (2015). Prevalence of musculoskeletal pain in construction workers in Saudi Arabia. T*heScientificWorldJourna*l, 2015, 529873. Retrieved from https://doi.org/10.1155/2015/529873

Almalki, M. M., Algarni, S. S., Almansouri, B. H., & Aldowsari, M. A. (2017). Use of smartphones, iPads, laptops and desktops as a risk factor for non-specific neck pain among undergraduate university students. Egyptian *Journal of Hospital Medicine, 69*(5), 2438–2441. Retrieved from https://doi.org/10.12816/0041690

Almogbil, I. H., Alrashidi, L. R., Alhajlah, R. S., Alqasim, A. K., Alharbi, N. S., Alghamdi, M. A., & Alshahrani, A. H. (2023). Prevalence of Shoulder and Neck Pain Among Healthcare Workers in the Central Region of Saudi Arabia. *Cureus, 15*(7), e42286. Retrieved from https://doi.org/10.7759/cureus.42286

Al-Mohrej, O. A., AlShaalan, N. S., Al-Bani, W. M., Masuadi, E. M., & Almodaimegh, H. S. (2016). Prevalence of musculoskeletal pain of the neck, upper extremities and lower back among dental practitioners working in Riyadh, Saudi Arabia: a cross-sectional study. *BMJ open, 6*(6), e011100. Retrieved from https://doi.org/10.1136/bmjopen-2016-011100

Al-Mohrej, O. A., Elshaer, A. K., Al-Dakhil, S. S., Sayed, A. I., Aljohar, S., AlFattani, A. A., & Alhussainan, T. S. (2020). Work-related musculoskeletal disorders among Saudi orthopedic surgeons: a cross-sectional study. *Bone & joint open, 1(*4), 47–54. Retrieved from https://doi.org/10.1302/2633-1462.14.BJO-2020-0005

Al-Mohrej, O. A., Elshaer, A. K., Al-Dakhil, S. S., Sayed, A. I., Aljohar, S., AlFattani, A. A., & Alhussainan, T. S. (2020). Work-related musculoskeletal disorders among Saudi orthopedic surgeons: a cross-sectional study. *Bone & joint open, 1*(4), 47–54. Retrieved from https://doi.org/10.1302/2633-1462.14.BJO-2020-0005

AlZarea, B. K., & Patil, S. R. (2015). *Mobile phone head and neck pain syndrome*: proposal of a new entity. Headache, 251(63), 313-317.

Bazazan, A., Dianat, I., Feizollahi, N., Mombeini, Z., Shirazi, A. M., & Castellucci, H. I. (2019). Effect of a posture correction-based intervention on musculoskeletal symptoms and fatigue among control room operators. *Applied ergonomics*, *76*, 12–19. Retrieved from https://doi.org/10.1016/j.apergo.2018.11.008

Bubric, K., & Hedge, A. (2016). Differential patterns of laptop use and associated musculoskeletal discomfort in male and female college students. Work (*Reading, Mass.)*, *55*(3), 663–671. Retrieved from https://doi.org/10.3233/WOR-162419

Ceolini, E., & colleagues. (2024). The aging brain and executive functions revisited: Implications from meta-analytic and functional-connectivity evidence. *Journal of Cognitive Neuroscience*, 33(9), 1716–1752. Retrieved from https://doi.org/10.1162/jocn_a_01616PMC

Cha, J. H., Choi, Y. J., Ryu, S., & Moon, J. H. (2023). *Association between smartphone usage and health outcomes of adolescents*: A propensity analysis using the Korea youth risk behavior survey. PloS one, 18(12), e0294553. Retrieved from https://doi.org/10.1371/journal.pone.0294553

China Internet Network Information Center. (2024). The 53rd statistical report on China's internet development status. *Journal of National Library of China (02)*, 104. Retrieved from https://doi.org/

China Sleep Research Society. (2024). *White paper on the sleep health of Chinese residents* 2024. Retrieved from http://www.csrs.org.cn/white-paper-2024

David, D., Giannini, C., Chiarelli, F., & Mohn, A. (2021). Text Neck Syndrome in Children and Adolescents. International *journal of environmental research and public health, 18*(4), 1565. Retrieved from https://doi.org/10.3390/ijerph18041565

Davies, K., Weale, V., & Oakman, J. (2023). A participatory ergonomics intervention to re-design work and improve the musculoskeletal health of paramedics: protocol for a cluster randomised controlled trial. *BMC musculoskeletal disorders, 24*(1), 716. Retrieved from https://doi.org/10.1186/s12891-023-06834-8

De la Corte-Rodriguez, H., Roman-Belmonte, J. M., Resino-Luis, C., Madrid-Gonzalez, J., & Rodriguez-Merchan, E. C. (2024). The Role of Physical Exercise in Chronic Musculoskeletal Pain: Best Medicine-A Narrative Review. *Healthcare (Basel, Switzerland), 12*(2), 242. Retrieved from https://doi.org/10.3390/healthcare12020242

Diao, T. C. (2002). Diagnosis, treatment, and rehabilitation of common shoulder and neck pain in the community. *Chinese Journal of Rehabilitation Theory and Practice, (4*). Retrieved from https://doi.org/CNKI:SUN:ZKLS.0.2002-04-009

Donghui Ren (2024) Google Map.https://maps.app.goo.gl/Pkn12rdowB5nfpV98

Eardley, R., Roudaut, A., Gill, S., & Thompson, S. (2018). Investigating how smartphone movement is affected by body posture. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (pp. 1–10). Association for Computing Machinery. Retrieved from https://doi.org/10.1145/3173574.3173776

Elsiddig, A. I., Altalhi, I. A., Althobaiti, M. E., Alwethainani, M. T., & Alzahrani, A. M. (2022). Prevalence of neck and shoulder pain among Saudi universities' students who are using smartphones and computers. *Journal of family medicine and primary care, 11*(1), 194–200. Retrieved from https://doi.org/10.4103/jfmpc.jfmpc_1138_21

Fortunato, L., Lo Coco, G., Teti, A., Bonfanti, R. C., & Salerno, L. (2023). Time Spent on Mobile Apps Matters: A Latent Class Analysis of Patterns of Smartphone Use among Adolescents. *International journal of environmental research and public health, 20*(15), 6439. Retrieved from https://doi.org/10.3390/ijerph20156439

Frydenlund, G., Guldager, J. D., Frederiksen, K. O., & Egebæk, H. K. (2023). Do young people perceive their smartphone addiction as problematic? A study in Danish university college students. *Heliyon, 9*(10), e20368. Retrieved from https://doi.org/10.1016/j.heliyon.2023.e20368

Gao, Y., Chen, Z., Chen, S., Wang, S., & Lin, J. (2023). Risk factors for neck pain in college students: a systematic review and meta-analysis. BMC public health, 23(1), 1502. Retrieved from https://doi.org/10.1186/s12889-023-16212-7

Górecki, A., Kiwerski, J., Kowalski, I. M., Marczyński, W., Nowotny, J., Rybicka, M. ... Szelachowska-Kluza, W. (2009). Prophylactics of postural deformities in children and youth carried out within the teaching environment – experts recommendations. *Polish Annals of Medicine*, *16*(1), 168-177. Retrieved from https://doi.org/10.29089/paom/162260

Griffiths, K. L., Mackey, M. G., Adamson, B. J., & Pepper, K. L. (2012). Prevalence and risk factors for musculoskeletal symptoms with computer based work across occupations. *Work (Reading, Mass.), 42*(4), 533–541. Retrieved from https://doi.org/10.3233/WOR-2012-1396

Guo, Y., Wang, Y., & Cao, J. C. (2021). The effect of functional training on poor posture in adolescents. *Fujian Sports Science and Technology, 40*(5).

Gustafsson, E., Thomée, S., Grimby-Ekman, A., & Hagberg, M. (2017). Texting on mobile phones and musculoskeletal disorders in young adults: A five-year cohort study. *Applied ergonomics, 58*, 208–214. Retrieved from https://doi.org/10.1016/j.apergo.2016.06.012

Hashem, M., Almohaini, R. A., Alharbi, T. M., Aljurfi, M. M., Alzmamy, S. A., Alhussainan, F. S., & Aldhafyan, A. E. (2024). Impact of Neck and Shoulder Pain on Health-Related Quality of Life in Adults in Saudi Arabia. *Cureus, 16*(4), e59252. Retrieved from https://doi.org/10.7759/cureus.59252

Huang, R. X., Yu, Y., Liu, W. D., Dai, R. L., & Xue, J. J. (2023). Investigation and analysis of posture problems among sedentary office workers and research on health dance intervention solutions. In Proceedings of the 4th "National Fitness-Scientific Exercise" Academic Conference and International Forum on Sports and Health (p. 87)

Irfan, M., Qurat-Ul-Ain, Iqbal, M. O., Chen, J., Khan, M. K., Sattar, M., & Khan, I. A. (2023). Association between anthropometric measurements of chairs and biomechanical variables leading to musculoskeletal problems in students at different government universities of Multan. *American journal of translational research, 15(*10), 6136–6147.

Jacquier-Bret, J., & Gorce, P. (2023). Effect of day time on smartphone use posture and related musculoskeletal disorders risk: a survey among university students. *BMC musculoskeletal disorders, 24*(1), 725. Retrieved from https://doi.org/10.1186/s12891-023-06837-5

Jaworski, Ł. M., Zabrzyński, J., Millett, P. J., Rupp, M. C., Familiari, F., Huri, G., Antosik, P., Błachowski, M., Wiciński, M., & Gagat, M. (2024). The Association of Tobacco Smoking and Level of Apoptosis in the Long Head of the Biceps Chronic Tendinopathy-An Immunohistochemical Study. *Journal of clinical medicine*, *13*(3), 684. Retrieved from https://doi.org/10.3390/jcm13030684

Jiao, Z. Y. (2024, June 3). Presenting new sounds and experiences of contemporary Chinese music to the world. Shenzhen Special Zone Daily, A07.

Kim, H. J., DH, & Kim, J. S. (2015). The relationship between smartphone use and subjective musculoskeletal symptoms and university students. *Journal of physical therapy science*, *27*(3), 575–579. Retrieved from https://doi.org/10.1589/jpts.27.575

Lee, S., DE Barros, F. C., DE Castro, C. S. M., & DE Oliveira Sato, T. (2021). Effect of an ergonomic intervention involving workstation adjustments on musculoskeletal pain in office workers-a randomized controlled clinical trial. *Industrial health*, *59*(2), 78–85. Retrieved from https://doi.org/10.2486/indhealth.2020-0188

Li, F., & Pan, Y. F. (2023). The impact of mobile phone use on college students and countermeasures. *Journal of Chuxiong Normal University*, (6), 135-138. Retrieved from https://doi.org/

Li, Y. W., Zhai, Y., Liu, Z. Y., Yan, Y. R., Xia, J. Y., & Deng, G. Y. (2020). Investigation of college students' electronic device usage habits and correlation analysis with neck-shoulder pain. *Modern Preventive Medicine, 47*(17), 3197–3201. Retrieved from https://doi.org/

Li, Z. F. (2024, May 27). China's satellite navigation and location service output value exceeds 530 billion yuan. China High-Tech Industry Herald, 002.

Liang, X., Xiong, F., & Xie, F. (2022). The effect of smartphones on the self-rated health levels of the elderly. *BMC public health, 22*(1), 508. Retrieved from https://doi.org/10.1186/s12889-022-12952-0

Liao, T., Li, L., & Wang, Y. T. (2019). Effects of Functional Strength Training Program on Movement Quality and Fitness Performance Among Girls Aged 12-13 Years. *Journal of strength and conditioning research, 3*3(6), 1534–1541. Retrieved from https://doi.org/10.1519/JSC.0000000000002190

Lin, Y. T. (2023). The adverse effects of rounded shoulders and hunchback posture on muscles and bones and treatment strategies. *Journal of Chinese Folk Therapies*, (8), 24–26. Retrieved from https://doi.org/10.19621/j.cnki.11-3555/r.2023.0808

Liu, Q. Z., & Wang, Y. (2022). Research on poor physical posture among contemporary college students and coping strategies In Proceedings of the First Belt and Road International Summit Forum on Physical Fitness (pp. 140-141).

Ludwig, O., Kelm, J., Hammes, A., Schmitt, E., & Fröhlich, M. (2018). Targeted Athletic Training Improves the Neuromuscular Performance in Terms of Body Posture From Adolescence to Adulthood - Long-Term Study Over 6 Years. *Frontiers in physiology, 9*, 1620. Retrieved from https://doi.org/10.3389/fphys.2018.01620

Ma, X. Y. (2024). Exploring the value of mobile photography in social media. *Journalist's Cradle,* (06), 30–32. Retrieved from https://doi.org/

Maayah, M. F., Nawasreh, Z. H., Gaowgzeh, R. A. M., Neamatallah, Z., Alfawaz, S. S., & Alabasi, U. M. (2023). Neck pain associated with smartphone usage among university students. *PloS one, 18*(6), e0285451. Retrieved from https://doi.org/10.1371/journal.pone.0285451

Majumder, S., & Deen, M. J. (2019). Smartphone Sensors for Health Monitoring and Diagnosis. *Sensors (Basel, Switzerland), 19*(9), 2164. Retrieved from https://doi.org/10.3390/s19092164

Malaysian Communications and Multimedia Commission. (2020). Internet users survey 2020. Retrieved from https://www.mcmc.gov.my/en/resources/statistics/internet-users-survey

Mongkonkansai, J., Veerasakul, S., Tamrin, S. B. M., & Madardam, U. (2022). Predictors of Musculoskeletal Pain among Primary School Students Using Smartphones in Nakhon Si Thammarat, Thailand. *International journal of environmental research and public health, 19(*17), 10530. Retrieved from https://doi.org/10.3390/ijerph191710530

Nejati, P., Lotfian, S., Moezy, A., Moezy, A., & Nejati, M. (2014). The relationship of forward head posture and rounded shoulders with neck pain in Iranian office workers. *Medical journal of the Islamic Republic of Iran, 28, 2*6.

Nguyen, T. M., Nguyen, V. H., & Kim, J. H. (2021). Physical Exercise and Health-Related Quality of Life in Office Workers: A Systematic Review and Meta-Analysis. International *journal of environmental research and public health, 18*(7), 3791. Retrieved from https://doi.org/10.3390/ijerph18073791

Nielsen, J. V., & Arvidsen, J. (2021). Left to Their Own Devices? A Mixed Methods Study Exploring the Impacts of Smartphone Use on Children's Outdoor Experiences. International *journal of environmental research and public health, 18*(6), 3115. Retrieved from https://doi.org/10.3390/ijerph18063115

Nishikawa, Y., Watanabe, K., Chihara, T., Sakamoto, J., Komatsuzaki, T., Kawano, K., Kobayashi, A., Inoue, K., Maeda, N., Tanaka, S., & Hyngstrom, A. (2022). Influence of forward head posture on muscle activation pattern of the trapezius pars descendens muscle in young adults. *Scientific reports, 12*(1), 19484. Retrieved from https://doi.org/10.1038/s41598-022-24095-8

Pandve, H. T. (2017). Historical milestones of ergonomics: from ancient human to modern human. *Journal of Ergonomics, 7(*4), 169.

Papatheocharous, E., Kaiser, C., Moser, J., & Stocker, A. (2023). Monitoring Distracted Driving Behaviours with Smartphones: An Extended Systematic Literature Review. *Sensors (Basel, Switzerland), 23*(17), 7505. Retrieved from https://doi.org/10.3390/s23177505

Peterson, G., & Pihlström, N. (2021). Factors associated with neck and shoulder pain: a cross-sectional study among 16,000 adults in five county councils in Sweden. *BMC musculoskeletal disorders, 22*(1), 872. Retrieved from https://doi.org/10.1186/s12891-021-04753-0

Pintakham, K., & Siriwong, W. (2016). Effectiveness of the multidimensional ergonomic intervention model to reduce musculoskeletal discomfort among street sweepers in Chiang Rai Province, Thailand. *Risk Management and Healthcare Policy, 9,* 275–283. Retrieved from https://doi.org/10.2147/RMHP.S110864

Plandowska, M., Labecka, M. K., Truszczyńska-Baszak, A., Płaszewski, M., Rajabi, R., Makaruk, B., & Różańska, D. (2024). The Effect of an Active Break Intervention on Nonspecific Low Back Pain and Musculoskeletal Discomfort during Prolonged Sitting among Young People-Protocol for a Randomized Controlled Trial. *Journal of clinical medicine, 13*(2), 612. Retrieved from https://doi.org/10.3390/jcm13020612

Qi, Q., Sun, Q., Yang, L. et al. High nutrition literacy linked with low frequency of take-out food consumption in chinese college students. *BMC Public Health 23,* 1132 (2023). Retrieved from https://doi.org/10.1186/s12889-023-16078-9

Savaş, B. B., Alparslan, G. B., & Korkmaz, C. (2019). Effect of flaxseed poultice compress application on pain and hand functions of patients with hand osteoarthritis. *Clinical rheumatology, 38*(7), 1961–1969. Retrieved from https://doi.org/10.1007/s10067-019-04484-7

Simon, L., Bourgeois, B. L., & Molina, P. E. (2023). Alcohol and Skeletal Muscle in Health and Disease. *Alcohol research: current reviews, 43*(1), 04. Retrieved from https://doi.org/10.35946/arcr.v43.1.04

Sirajudeen, M. S., Alzhrani, M., Alanazi, A., Alqahtani, M., Waly, M., Manzar, M. D., Hegazy, F. A., Mohd Jamali, M. N. Z., Reddy, R. S., Kakaraparthi, V. N., Unnikrishnan, R., Muthusamy, H., Alrubaia, W., Alanazi, N., Kashoo, F. Z., & Miraj, M. (2022). Prevalence of Upper Limb Musculoskeletal Disorders and Their Association with Smartphone Addiction and Smartphone Usage among University Students in the Kingdom of Saudi Arabia during the COVID-19 Pandemic-A Cross-Sectional Study. *Healthcare (Basel, Switzerland), 10*(12), 2373. Retrieved from https://doi.org/10.3390/healthcare10122373

Stolinski, L., Kozinoga, M., Czaprowski, D., Tyrakowski, M., Cerny, P., Suzuki, N., & Kotwicki, T. (2017). Two-dimensional digital photography for child body posture evaluation: standardized technique, reliable parameters and normative data for age 7-10 years. *Scoliosis and spinal disorders, 12*, 38. Retrieved from https://doi.org/10.1186/s13013-017-0146-7

Sun, Z. S., Cai, X. G., Cao, L. S., Zou, L. L., Gao, J. H., Chang, J. Q., & Wang, X. F. (2023). Clinical efficacy of cervical stabilization training on postural correction and functional status in patients with cervical spondylosis. *Chinese Journal of Rehabilitation, (*1), 34–37. Retrieved from https://doi.org/CNKI:SUN:ZLKF.0.2023-01-008

Tahernejad, S., Razeghi, M., Abdoli-Eramaki, M., Parsaei, H., Seif, M., & Choobineh, A. (2021). Recommended maximum holding time of common static sitting postures of office workers. *International Journal of Occupational Safety and Ergonomics, 29*, 847 - 854.

Takasawa, E., Yamamoto, A., Kobayashi, T., Tajika, T., Shitara, H., Ichinose, T., Mieda, T., Iizuka, Y., Iizuka, H., & Takagishi, K. (2015). Characteristics of neck and shoulder pain in the Japanese general population. Journal of orthopaedic science : *official journal of the Japanese Orthopaedic Association, 20*(2), 403–409. Retrieved from https://doi.org/10.1007/s00776-014-0676-2

Talebi, E., Mohaddesi, H., Vahabzadeh, D., & Rasuli, J. (2022). Examination of influence of social media education through mobile phones on the change in physical activity and sedentary behavior in pregnant women: a randomized controlled trial. *BMC women's health, 22*(1), 152. Retrieved from https://doi.org/10.1186/s12905-022-01725-x

Tang, Z. (2022). Uses and gratifications: A study on user motivation for mobile entertainment in the mobile internet era—Taking Game for Peace as an example. *News Outpost, (4),* 60–61. Retrieved from https://doi.org/

Toh, S. H., Coenen, P., Howie, E. K., Smith, A. J., Mukherjee, S., Mackey, D. A., & Straker, L. M. (2020). A prospective longitudinal study of mobile touch screen device use and musculoskeletal symptoms and visual health in adolescents. *Applied ergonomics, 85*, 103028. Retrieved from https://doi.org/10.1016/j.apergo.2019.103028

Verdú, E., Homs, J., & Boadas-Vaello, P. (2021). Physiological Changes and Pathological Pain Associated with Sedentary Lifestyle-Induced Body Systems Fat Accumulation and Their Modulation by Physical Exercise. *International journal of environmental research and public health, 18(*24), 13333. Retrieved from https://doi.org/10.3390/ijerph182413333

Wang, A., Zhou, Y., Li, X., Wang, W., Zhao, X., Chen, P., & Liao, W. (2024). Investigating and analyzing the current situation and factors influencing chronic neck, shoulder, and lumbar back pain among medical personnel after the epidemic.BMC musculoskeletal disorders, 25(1), 316. Retrieved from https://doi.org/10.1186/s12891-024-07425-x

Wang, J. Z. (2018). Design and implementation of a mobile office system for small and medium-sized enterprises [Master's thesis, Qingdao University]. CNKI. Retrieved from https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202001&filename=1019625286.nh

Wang, K. J. (2024, May 27). Convenient payment "assists" global business at the doorstep. *China Business Journal,* B06

Wang, N. (2016). Effects of physical functional training on college students' physical fitness: An experimental study [Master's thesis, Shanxi Normal University]. Retrieved from https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201701&filename=1016100494.nh

Wang, R., Yin, Y., Zhang, H., Pan, L., Zhu, Y., Wang, M., Huang, Z., Wang, W., & Deng, G. (2023). Risk factors associated with the prevalence of neck and shoulder pain among high school students: A cross-sectional survey in China. *BMC Musculoskeletal Disorders, 24*, Article 641. Retrieved from https://doi.org/10.1186/s12891-023-06656-8

Wang, Z., Ma, H., Zhang, W., Zhang, Y., Youssef, L., Carneiro, M. A. S., Chen, C., Wang, D., & Wang, D. (2024). Effects of Functional Strength Training Combined with Aerobic Training on Body Composition, Physical Fitness, and Movement Quality in Obese Adolescents. *Nutrients, 16*(10), 1434. Retrieved from https://doi.org/10.3390/nu16101434

Weleslassie, G. G., Meles, H. G., Haile, T. G., & Hagos, G. K. (2020). Burden of neck pain among medical students in Ethiopia. *BMC musculoskeletal disorders, 21*(1), 14. Retrieved from https://doi.org/10.1186/s12891-019-3018-x

Wu, B., & Ren, H. (2021). Research on the intervention of functional training on college students' high and low shoulders. In Proceedings of the 8th China Physical Fitness Summit Forum and the 2nd China Physical Fitness Training Annual Meeting (pp. 330–334).

Wunderle, V., Kuzu, T. D., Tscherpel, C., Fink, G. R., Grefkes, C., & Weiss, P. H. (2024). *Age- and sex-related changes in motor functions: A comprehensive assessment and component analysis*. *Frontiers in Aging Neuroscience*, 16, Article 1368052. Retrieved from https://doi.org/10.3389/fnagi.2024.1368052

Xi, Y. B. (2004). The concept of physical exercise and its methodological system: A study. *Journal of Beijing Sport University, (1),* 118–120. Retrieved from https://doi.org/10.19582/j.cnki.11-3785/g8.2004.01.045

Xie, Y. F., Szeto, G., Madeleine, P., & Tsang, S. (2018). Spinal kinematics during smartphone texting: A comparison between young adults with and without chronic neck-shoulder pain. *Applied Ergonomics, 68*, 160–168. Retrieved from https://doi.org/10.1016/j.apergo.2017.10.018

Xu, H. R., Zhang, Y. H., Ngo, T. L., Yang, Q. H., Du, S. H., & Wang, X. Q. (2023). Association between smoking and incident back pain: A prospective cohort study with 438,510 participants. *Journal of Global Health, 13*, Article 04152. Retrieved from https://doi.org/10.7189/jogh.13.04152

Xu, Y. F., & Zhang, L. (2019). Evaluating the improvement effects of Tai Chi exercise on neck, shoulder, and low back pain in college students. *Chinese Journal of School Health, 40*(7), 4.

Xu, Y., & Xiao, D. (2024, March 28). 5G new calling enters a new era: Enjoying multimodal communication experiences. People's Posts and Telecommunications News, 005.

Yang, S., Boudier-Revéret, M., Yi, Y. G., Hong, K. Y., & Chang, M. C. (2023). Treatment of Chronic Neck Pain in Patients with Forward Head Posture: A Systematic Narrative Review. *Healthcare (Basel, Switzerland), 11*(19), 2604. Retrieved from https://doi.org/10.3390/healthcare11192604

Yang, X. (2024). Effects of staying up late on health-related physical fitness among students in the Department of Human Systems at Jilin Sport University. *Journal of Ice and Snow Sports Innovation Research,* (6), 130–132. Retrieved from https://doi.org/10.20155/j.cnki.issn2096-8485.2024.06.044

Ye, C. Q. (2023). Analysis of contemporary college students' ideological trends. [Editor's note]. In Proceedings of the 7th International Conference on Technological Innovation and Educational Development (Vol. 2, pp. 252-254).

Ye, J. (2024, May 22). From security to data integration: BestPay creates new digital pathways. Communication Information News, 004.

Yu, B. Y., Shen, J. Q., & Liu, Y. J. (2024, March 22). University students studying university students: Why do we stay up late. China Youth Daily, 005. Retrieved from http://www.cyol.com

Zhang, X. M. (2023). The impact of physical exercise on college students'quality of life under the COVID-19 pandemic: The mediating role of emotional regulation self-efficacy and psychological resilience [Master's thesis, Liaoning Normal University]. China National Knowledge Infrastructure. Retrieved from https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFDTEMP&filename=1023583474.nh

Zhao, Q. Y. (2022). Assessment, screening, and exercise intervention for abnormal body posture in female college students at normal universities [Master's thesis, Yunnan Normal University]. Retrieved from https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202301&filename=1022611178.nh.

APPENDIX

Appendix A

Interview forms

Behavior to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong campus

Consent Day Date.....Month.....Year.....

I am Mr. / Mrs. / Miss. . . . . .

address.....

Read the details from the information sheet for participants in the research project and I agree to voluntarily participate in the research project.

I have received a copy of the consent form that I signed and dated, along with an information sheet for research participants. This is before signing the consent form to conduct this research. I explained to the researcher the purpose of the study. The duration of the research, research methods, dangers or symptoms that may arise from the research. or from the medicine used Including the benefits that will emerge from the research and guidelines for treatment by other methods in detail, I have had enough time and opportunity to ask questions until I have a good understanding. The researcher answered various questions willingly and without concealment until I was satisfied.

I have the right to terminate my participation in the research project at any time. There is no need to inform the reason. and termination of my involvement in

this research It will not affect treatment or other rights that I will continue to receive.

The researcher guarantees that my personal information will be kept secret. and will be disclosed only with my consent. Other persons on behalf of the research sponsoring company Human Research Ethics Committee the Food and Drug Administration may be permitted to inspect and process my information. This must be done to verify the accuracy of the information only. By agreeing to participate in this study, I am giving consent to have my medical history reviewed.

I have read the above and have a complete understanding of it. Willing to participate in research willingly. Therefore, signed this consent document.

.....Sign the person giving consent.

(.....) Name of person giving consen

Date .....Month.....Year.....

I have explained the purpose of the research, the research methods, dangers or adverse reactions or risks that may arise from the research. or from the medicine used Including the benefits that will arise from thorough research. Let the participants in the research project named above know and have a good understanding. Ready to sign the consent document willingly

.....

Signed by the researcher

(.....)

Name of the researcher in detail

Date .....Month……..Year…….

.....	.....
Witness signature	Witness signature
(.....)	(.....)
Name of witness in detail	Name of witness in detail
Date .....Month…..Year…….	Date .....Month……..Year…….

Behavior to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong campus.

…….

Dear Participants

The research study will be conducted on the prevalence, and level of neck and shoulder pain, behavior to prevent neck and shoulder pain, and identify the risk factor related to neck and shoulder pain behavior prevention among student smartphone users among students of smartphone users at Hainan Vocational University of Science and Technology in Yunlong campus. The participants in this study are voluntary and the information you give us will be confidential, which means your name will not be mentioned anywhere and information provided by you will be presented only in a summarized form.

Please select carefully the answer for each question and the possible responses. Choose and mask (√) the response option that best represents your opinion, knowledge, attitude, and practice. Please notify the interviewer if you have any concerns about the questions or other problems.

The questionnaire is divided into 4 parts as follows;

Part I Personal factors

Part II Factors of characteristics of using a Smartphone

Part III Musculoskeletal Discomfort Assessment (MSDA)

Part IV Behaviors to prevent neck and shoulder pain

The researcher hopes for your cooperation very much and I would like to thank you very much for this opportunity.

Doghui Ren

Master of Public Health

Chiang Rai Rajabhat University

Part I Personal factors

Guidance: Please select carefully the answer for each question and choose the answer by marking (√) the response option that best represents.

Details	**Code**
1. Gender	Gender……..
( ) Male ( ) Female	
2. Age ……. years	Age……
3. Year of study	Year……..
( ) Year 1 ( ) Year 2 ( ) Year 3 ( ) Year 4	
4. Faculty	Faculty ……
( ) Faculty of Medicine ( ) Faculty of Nursing ( ) Faculty of Accountancy ( ) Faculty of Urban Construction ( ) Faculty of Education and Music	
5. Current address	Address……
( ) City ( ) Village	
6. Height……. centimeter	Height……

Details	**Code**
7. Weight……. kilogram	Weight……
8. Smoke	Smoke……
( ) No ( ) Yes	
9. Drink	Drink……
( ) No ( ) Yes	
10. Physical exercise habit	Habit……
( ) No ( ) Yes	

Part II Factors of characteristics of using a Smartphone

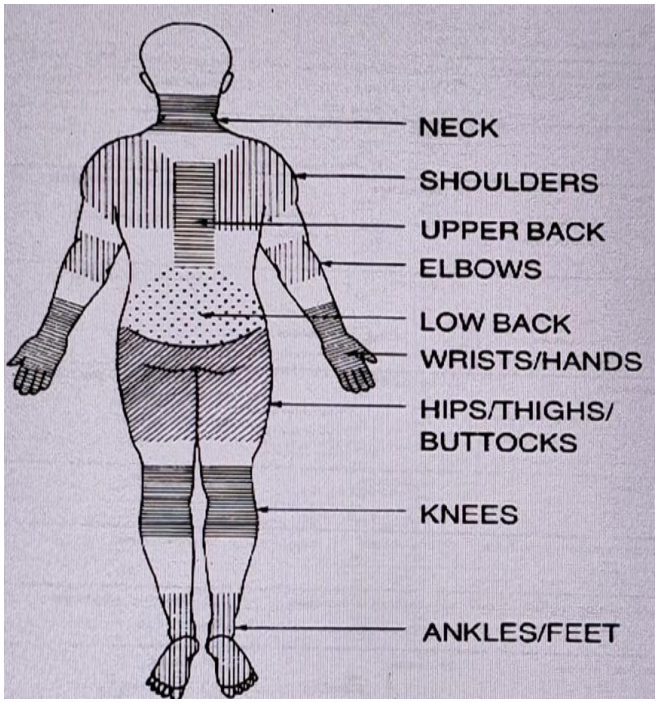
Guidance: Please select carefully the answer for each question and choose the answer by marking (√) the response option that best represents

Details	**Code**
1. play smartphone in class	Play……
（ ）1.Never （ ）2.Occasionally （ ）3. Always	
2. Do you use your smartphone every day to read, play games, watch videos, chat, or other software?	Use……
（ ）No （ ）Yes	
3. How many social media platforms do you use in the day? (Such as WeChat, LINE, Facebook, TikTok, and other software)	Software…
（ ）One （ ）Two （ ）Three （ ）More than four	
4. How many hours a day do you spend on your smartphone?	Hr……
Total time usage per day_____(hr)	

5. When you use a smartphone to do these activities (such as chatting, playing games, watching videos, reading, etc.), do you have a break?	Break……
（）No （）Yes	
6. Do you still use a laptop/tablet besides a smartphone?	still
（）No （）Yes	
7. How do you hold a smartphone when you use it?	hold
（）Below eye level （）At eye level （）Above eye level	
8. Handedness	Handedness
（）Right-handed （）Left -handed （）both handed	
9. The most frequently used activities on smartphones	Activities
（）Scheduling work （）talking on the phone （）listening to music （）watching videos （）Send and receive messages （）play games （）Other(please specify)……	

Part III Musculoskeletal Discomfort Assessment (MSDA)

Guidance: The following questions ask how you feel about your body discomfort. Please select carefully the answer for each question and choose the answer by marking (√) the response option that best represents.



Body Region	**Have you had trouble at any during the last months**	**Level to pain** **No pain----------More pain** **0 1 2 3 4 5 6 7 8 9 10**										
Neck	☐ No ☐ Yes	0	1	2	3	4	5	6	7	8	9	10
Shoulder												
Right	☐ No ☐ Yes											
Left	☐ No ☐ Yes											

Part IV Behaviors to prevent neck and shoulder pain

Guidance: Please answer by marking (√) the response option that best represents yours opinion as follows.

Always	means practice every day	4 scores
Often	means Practice 4-6 days per week.	3 scores
Sometimes	means Practice 1-3 days per week.	2 scores
Never	means never practice	1 score

ID	Behaviors to prevent neck and shoulder pain	Always (4)	Often (3)	Sometime (2)	Never (1)
1	You should avoid using your smartphone continuously for 20 minutes to prevent neck and shoulder pain.				
2	You avoid bending your neck while using your smartphone to reduce the risk of neck and shoulder pain.				
3	You avoid elevating your smartphone above your shoulder, to reduce the risk of neck and shoulder pain.				

ID	Behaviors to prevent neck and shoulder pain	Always (4)	Often (3)	Sometime (2)	Never (1)
4	You avoid holding your smartphone on your lap, to prevent bending the neck				
5	You avoid sleeping on your side and using your smartphone because you have to tilt your head and lift one shoulder.				
6	You stretch your muscles when you have neck and shoulder pain				
7	You study information about preventing muscle pain from using a smartphone to prevent neck and shoulder pain.				
8	You use hot compresses when you have neck and shoulder pain.				
9	You take pain relievers or muscle relaxants because you use your smartphone?				

Appendix B

Validity and Reliability

Behavior to prevent neck and shoulder pain among students of smartphone users at Hainan Vocational University of Science and Technology in YunLong campus.

Part I Personal factors

Attention：Please mark your comments in the blanks as much as possible.

Question	Comment score			Total score	IOC	Summary
	1	2	3			
1.Gender （）Male （）Female	+1	+1	+1	3	1	/
2.Age.....years	+1	+1	+1	3	1	/
3.Class （）Class of 2021 （）Class of 2022 （）Class of 2023 （）Class of 2024	+1	0	0	1	0.3	x

Question	Comment score			Total score	IOC	Summary
	1	2	3			
4.Faculty （）Faculty of Medicine （）Faculty of Nursing （）Faculty of Accountancy （）Faculty of Urban Construction （）Faculty of Education and Mucis	+1	+1	+1	3	1	/
5.Current address （）City （）Village	+1	+1	+1	3	1	/
6.Height.....centimeter	+1	+1	+1	3	1	/
7.Weight.....kilogram	+1	+1	+1	3	1	/
8.Smoke （）No （）Yes (specify).....cigarettes a day	+1	+1	+1	3	1	/

Question	Comment score			Total score	IOC	Summary
	1	2	3			
9.Drink （）No （）Yes (specify).....glasses a day	+1	+1	+1	3	1	/
10.Physical exercise habit （）No （）Yes (specify).....times/week	+1	+1	+1	3	1	/

Part II: Factors of characteristics of using a Smartphone

Attention： Please mark your comments in the blanks as much as possible.

Question	Comment score			Total score	IOC	Summary
	1	2	3			
1. Play smartphone in class （）Never （）Occasionally （）Always	+1	+1	+1	3	1	/
2. Time on the smartphone in class （）Below 10 hr （）10-20 hr （）20-30 hr （）Over 30 hr	+1	0	+1	2	0.6	/
3. Do you use your smartphone every day to read, play games, watch videos, chat, or other software? （）No （）Yes	-1	+1	0	0	0	x

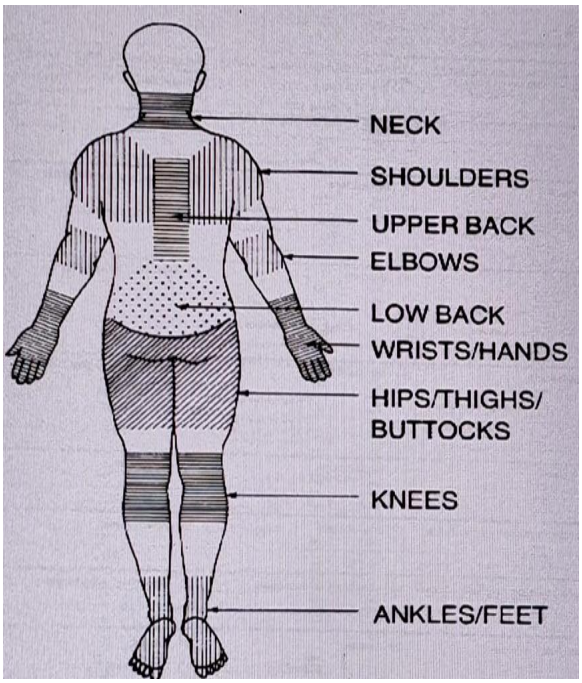
Question	Comment score			Total score	IOC	Summary
	1	2	3			
4. How many social media software do you use in the day? (Such as WeChat, LINE, Facebook, TikTok and other software) （）One （）Two （）Three （）More than four	-1	+1	+1	1	0.3	x
5. How many hours a day do you spend on your smartphone? Total time usage per day (hr) or (min)	+1	+1	+1	3	1	/

Question	Comment score			Total score	IOC	Summary
	1	2	3			
6. When you use a smartphone to do these activities (such as chatting, playing games, watching videos, reading, etc.), do you have a break? （）No （）Yes	0	+1	+1	2	0.6	/
7. Do you still use a laptop / tablet besides a smartphone? （）No （）Yes	+1	+1	+1	3	1	/
8. How do you hold a smartphone when you use it? （）Below eye level （）At eye level （）Above eye level	+1	+1	+1	3	1	/

Question	Comment score			Total score	IOC	Summary
	1	2	3			
9. Handedness （）Right-handed （）Left -handed （）both handed	0	+1	+1	2	0.6	/
10. The most frequently used activities on smartphones （）Scheduling work （）Talking on the phone （）Listening to music （）Watching videos （）Send and receive messages （）Play games （）Other	0	+1	+1	2	0.6	/

Part III Musculoskeletal Discomfort Assessment (MSDA)

Attention：Please mark your comments in the blanks as much as possible.



Body Region	**Have you had trouble at any during the last months**	**Level to pain** **No pain----------More pain** **0 1 2 3 4 5 6 7 8 9 10**											**score**			**Total score**	**IOC**	**Summary**
													1	**2**	**3**			
Neck	☐ No ☐ Yes	0	1	2	3	4	5	6	7	8	9	10	+ **1**	+ **1**	+ **1**	3	1	/
Shoulder																		
Right	☐ No ☐ Yes												+ **1**	+ **1**	+ **1**	3	1	/
Left	☐ No ☐ Yes												+ **1**	+ **1**	+ **1**	3	1	/

Part IV Behaviors to prevent neck and shoulder pain

Attention：Please mark your comments in the blanks as much as possible.

Question	Comment score			Total score	IOC	Summary
	1	2	3			
1.You should avoid using your smartphone continuously for 20 minutes to prevent neck and shoulder pain. （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/
2.Avoid bending your neck while using your smartphone to reduce the risk of neck and shoulder pain. （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/

Question	Comment score			Total score	IOC	Summary
	1	2	3			
3.Avoid elevating your smartphone above your shoulder, to reduce the risk of neck and shoulder pain. （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/
4.You avoid holding your smartphone on your lap, to prevent bending the neck （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/

Question	Comment score			Total score	IOC	Summary
	1	2	3			
5. You avoid sleeping on your side and using your smartphone because you have to tilt your head and lift one shoulder. （） Always （） Often （） Sometime （） Never	+1	+1	+1	3	1	/
6.You stretch your muscles when you have neck and shoulder pain （） Always （） Often （） Sometime （） Never	+1	+1	+1	3	1	/

Question	Comment score			Total score	IOC	Summary
	1	2	3			
7. You study information about preventing muscle pain from using a smartphone to prevent neck and shoulder pain. （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/
8. If you use your smartphone continuously, you will take a break every 20 minutes to prevent neck and shoulder pain （）Always （）Often （）Sometime （）Never	0	0	+1	1	0.3	x

Question	Comment score			Total score	IOC	Summary
	1	2	3			
9.You use hot compresses when you have neck and shoulder pain. （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/
10.You take pain relievers or muscle relaxants because you use your smartphone? （）Always （）Often （）Sometime （）Never	+1	+1	+1	3	1	/

Measurement	Conbach's alpha coefficient
Musculoskeletal Discomfort ssessment	0.754
Behaviors to prevent neck and shoulder pain	0.911

Appendix C

Activity pictures

BIOGRAPHY

Name - Surname Ms.Ren Donghui

Date of birth 8//October 2001

Current address

House number:No.89 Subdistrict Bandu District Mueang Province Chiang Rai

Educational record

Date:September2019-June 2023(Undergraduate)

Graduated from: Hainan Vocational University Of Science and Technology

Date:September2016-June 2019(Senior Hign School)

Graduated from: Runan Bilingual School

Date:September2013-June 2016(Junior Hign School)

Graduated from: Chang Xing No. 1 middle school

Date:September2007-June 2013(Primary School)

Graduated from: Baizhangtun Primary School

Work experience

Date: July 2023-January 2024, Workplace: Hainan Vocational University of Science and Technology

Address: No. 118, Yunding Road, Yunlong Town, Qiongshan District, Haikou City, Hainan Province

Date: May 2022-March 2023, Internship Unit: Hainan Provincial People's Hospital

Address: No. 19, Xiuhua Road, Xiuying District, Haikou City, Hainan Province